United States Court of Appeals

for the

District of Columbia Circuit

TRANSCRIPT OF RECORD

549

JOINT APPENDIX

IN THE

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 22,202

ALEXANDER P. DESEVERSKY, *Appellant*

v.

EDWARD J. BRENNER, Commissioner of Patents, *Appellee*

Appeal From the Judgment of the United States District Court for the District of Columbia

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PRESS OF BYRON S. ADAMS PRINTING, INC., WASHINGTON, D. C.

INDEX

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JOINT APPENDIX

Relevant Docket Entries

UNITED STATES DISTRICT COURT FOR THE DISTRICT OF COLUMBIA

1966

Sept. 2—Complaint, appearance. filed.

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Nov. 1—Answer of defendant to complaint; c/m 11/1/66; appearance of Joseph Schimmel. filed.

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1968

Jan. 24—Memorandum opinion; judgment for deft; counsel will prepare findings of fact & conclusions of law & order accordingly. (N) McGuire, J.

Feb. 19—Findings of fact and conclusions of law. (N) McGuire, J.

Feb. 19—Order dismissing complaint. McGuire, J.

Feb. 29—Motion of pltff for a new trial and to amend judgment; P&A; Exhibits (2); affidavit; c/m 2/28/68. M.C. filed.

Mar. 6—Memorandum of deft. in opposition to motion for a new trial and amend judgment; P&A; c/m 3/6/68. filed.

Mar. 12—Reply memorandum of plaintiff in support of motion under Rule 59A; c/m 3/12/68. filed.

Mar. 25—Transcript of proceedings; vol #1, pps 1 thru 103, Nov. 21, 1967; (Rep: Barbara A. Williamson) Court's Copy) filed.

Mar. 26—Memorandum denying plaintiff's motion under Rule 59 (a) (2) for a new trial and to amend the judgment, and to hold case until the Patent Office decides certain new issues. (n) McGuire, J.

May 14—Notice of appeal by plaintiff, copy mailed to John M. Calimafde, Michael Ebert and Hopgood and Calimafde; Deposit $5.00 by John F. Smith. filed.

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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

CIVIL ACTION No. 2344-'66

ALEXANDER P. DESEVERSKY, 30 Rockefeller Plaza, New York, New York, *Plaintiff*,

v.

EDWARD J. BRENNER, Commissioner of Patents, Washington, D. C., *Defendant*.

Bill of Complaint for Issuance of Letters Patent

Plaintiff, Alexander P. DeSeversky, complaining against the defendant, Commissioner of Patents, alleges as follows:

1. Plaintiff is a resident of Northport, Long Island, in the County of Nassau and the State of New York.

2. Defendant is the United States Commissioner of Patents, and is officially a resident of Washington, in the District of Columbia, within the jurisdiction of this Court.

3. This action is brought under the provisions of Title 35, U.S.C. Section 145.

4. Plaintiff is the applicant of an application for Letters Patent entitled "Wet Electrostatic Precipitator", bearing Serial Number 53,255, filed August 31, 1960.

5. The aforesaid application contains five claims, namely 20, 21, 23, 25 and 26, of which, claims 21, 23, 25 and 26 have been allowed by the United States Patent Office.

6. The aforesaid claim 20 was finally rejected in a certain official action rendered by the Patent Office, and the rejection affirmed in a decision by the Board of Appeals dated July 19, 1966.

7. The affirmed rejection of claim 20 is erroneous as the prior patents relied upon by the Patent Office do not anticipate the claim, and the differences between the claim and the prior art would not have been obvious to one skilled in the art to which the invention pertains at the time the invention was made.

8. For a great many years, there has been substantial effort to develop efficient apparatus for cleaning contaminated gases. The problem has become particularly acute in recent years because of the increasing air pollution due to the progressive industrialization of our society. Despite the extensive efforts by others, no one solved the problem satisfactorily before plaintiff's invention as defined by claim 20 of the aforesaid patent application. Plaintiff's invention solved the problem, and the solution has been widely recognized and acclaimed by authorities in the field.

9. Plaintiff makes profert of a certified copy of the aforesaid application for Letters Patent, and also proceedings and papers in the file thereof together with copies of the patents forming the basis for the aforesaid decision refusing to allow the claim, all of said copies to be produced if and when this Honorable Court shall direct.

WHEREFORE, Plaintiff respectfully prays for a decree pursuant to Title 35, U.S.C., Section 145, authorizing the Commissioner of Patents to issue Letters Patent, including claim 20, on the aforesaid application; and for such other and further relief as the nature of the case may admit or require and as may be just and equitable.

ALEXANDER P. DESEVERSKY

By .....

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Answer to Complaint

To the Honorable Judges of the United States District Court for the District of Columbia

1. Defendant admits, upon information and belief, the allegations of this paragraph of the complaint.

2-6. Defendant admits the allegations of these paragraphs of the complaint.

7. Defendant denies, for reasons hereinafter given, the allegations of the complaint.

8. Defendant is without knowledge or information sufficient to form a belief as to the truth of the allegations of this paragraph of the complaint, and, therefore, defendant denies said allegations.

9. Defendant admits the allegations of this paragraph of the complaint.

FURTHER ANSWERING defendant denies that plaintiff is entitled to a decree authorizing defendant to issue letters patent, including claim 20 of application Serial No. 43,255, as requested in the prayer of the complaint, because said claim is not patentable under the law, for the reasons given and in view of the prior patents cited and relied upon by the examiner in the Examiner's Answer, and by the Board of Appeals in its decision in said application. Profert of said patents, answer and decision is hereby made.

Respectfully submitted,

JOSEPH SCHIMMEL
Solicitor,
United States Patent Office
Attorney for the Defendant.

November 1, 1966

Wet Electrostatic Precipitator

This invention relates generally to apparatus for cleaning contaminated gases and more particularly to a wet electrostatic precipitator of exceptional efficiency. This application is a continuation-in-part of my co-pending application Ser. No. 855369, filed November 25, 1959, and issued September 11, 1962 as patent 3053029, which co-pending application is a division of my original application final No. 479, 909, filed January 5, 1955, and issued as patent 2937709 on May 24, 1960.

The increase in atmospheric pollution and smog in modern communities has created a health hazard of major proportions and has become a matter of grave social concern. Air pollution is imputable to many factors among which are the use of incinerators to burn household waste and various industrial operations which discharge combustion products into the atmosphere.

Electrostatic precipitators, both of the dry and wet type, have been used for cleaning contaminated gases, but such use has been limited mainly to industrial applications. There has not heretofore been available an inexpensive, efficient and reliable precipitator for non-industrial users, to be installed for example in apartment houses so as to prevent the discharge into the atmosphere of particles emanating from incinerator and heating systems.

The present invention deals with a precipitator of the wet type wherein the contaminated gases are conveyed through an electrostatic field between electrode surfaces. Particles in the gas are precipitated onto a collecting surface constituted by a film of water flowing over a collector. Since the water carries the particles away continuously, a precipitator of this type is self-cleaning and is therefore particularly suited to non-industrial uses. This wet type of precipitator is also advantageously used for extracting radioactive particles from the atmosphere in case of fallout. The dry type of precipitator would accumulate the ex-

tracted particles and become so highly radioactive that it would become a hazard itself. By using the wet type of precipitator, the radioactive material is carried away by the liquid which may then be stored or treated to decontaminate. While the present invention will be described in connection with a wet precipitator, it will become apparent that certain features of the invention are also applicable to dry precipitators.

One of the characteristic defects in existing wet precipitators arises from the fact that the liquid film is generally uneven and does not fully coat the collector surface. If the water is merely poured into the vertical collector tube of the precipitator, it tends to trickle down in separate streams and it is difficult to ensure that it will spread over the interior surface without an excessive flow of incoming water. As a result, dry patches appear on the collector and certain particles, such as carbon black, on reaching a dry area tend to give up their charge. These particles acquire an opposite charge by induction and may experience sufficient force in a strong field to be moved back toward the other electrode into the gas stream. As a consequence, the particles pass out of the cleaner and are discharged into the atmosphere.

Accordingly, it is one object of the invention to provide an electrostatic precipitator of the water film type wherein water is caused to flow uniformly and smoothly on the walls of the collector tubes, and wherein dry patches are obviated. A significant feature of the invention resides in the fact that a water distributor is provided which discharges multiple streams tangentially against the surface of the collector, the streams being divergent and intersecting.

Another factor which militates against the use of wet precipitators in non-industrial applications is the relatively high power requirements for the precipitator. It is the usual practice to pass the contaminated gas initially through a charging field in which a corona discharge is

produced in order to ionize the suspended particles. The gas then passes through an electrostatic precipitating field which is free of corona discharge, this field acting to cause migration of the particles toward the collecting electrode. The use of a pre-ionization field involves a relatively high voltage and in conventional precipitators brings about a substantial current flow. The power requirements of the pre-ionization field when added to that of the precipitating field are considerable and make the operation of the standard precipitator costly.

It is therefore another object of the invention to provide a wet electrostatic precipitator of high efficiency which requires substantially less power to operate than conventional gas cleaners.

A further object of the invention is to provide a power supply for a precipitator which generates pulsed voltages of high amplitude to produce an ionizing field.

Also an object of the invention is to provide a wet electrostatic precipitator which is of compact design and yet has a large gas cleaning capacity.

The wet precipitator in accordance with the invention is constituted by two concentric collector tubes, a water film being formed uniformly both on the outer surface of the inner tube and the inner surface of the outer tube by means of distributors producing multiple diverging streams of water which are introduced tangentially to the collector surface and intersect thereon. Precipitator and corona discharge electrodes are suspended in the annular passage between the two tubes to remove particles from the gas conveyed vertically thereon. Corona discharge voltages are applied in pulsatory form, whereas the lower precipitation voltage is maintained at a constant level.

For a better understanding of the invention as well as other features and objects thereof, reference is made to the following detailed description to be read in conjunction

with the accompanying drawing wherein like components in the several views are identified by like reference numerals.

In the drawings:

Fig. 1 is a perspective view of the precipitator cabinet.

Fig. 2 is a section taken through the precipitator structure in the vertical plane.

Fig. 3 is a transverse section taken in the plane indicated by line 3-3 in Fig. 2.

Fig. 4 is a linear projection of the flange water distributor.

Fig. 5 is a plan view of the flange.

Fig. 6 is an end view of the flange.

Fig. 7 shows the water distribution pattern produced by the flange.

Fig. 8 schematically shows one preferred form of pre-ionization and collector electrode structure in accordance with the invention.

Fig. 9 schematically shows another form of pre-ionization and collector electrode structure in accordance with the invention.

Fig. 10 shows the waveform of voltage applied to the structure shown in Fig 9.

Fig. 11 is a schematic view of a pulsating high voltage supply suitable for use in conjunction with the present invention.

Fig. 12 is a sectional view of a preferred form of a portion of the two shells forming the collector assembly.

Referring now to the drawings and more particularly to Fig. 1 to 3, a preferred embodiment of the wet precipitator in accordance with the invention is shown housed in a metal cabinet constituted by side panels 10, a base plate 11 and

a cover 12. The water supply for the precipitator is contained in a sliding tray 13 disposed at the bottom of the cabinet, and serving as a well. Mounted in the tray is a water pump 14, which may be electrically driven.

Vertically mounted within the cabinet is a collector assembly including a cylindrical inner collector shell 15. Concentrically disposed about the inner shell is an outer collector shell 16, an annular air passage 17 being defined between the shells. The outer shell is supported within the cabinet by means of a mounting ring 19.

Supported above the collector assembly at the top of the cabinet is a fan motor 20, the motor being positioned centrally within an inverted conical deflector 21. Positioned in the space between the deflector 21 and the collector assembly is a fan 22, the fan being attached to the shaft of motor 20. Air drawn by the fan 22 through the air passage 17 is exhausted through a set of louvred grills 23 mounted on the panels of the cabinet. Air enters the cabinet through a set of intake grills 24, the air being deflected upwardly into the air passage 17 by means of a truncated conical deflector 25.

Water sucked from tray 13 by the pump 14 is supplied through a flexible tube 26 to a water distributor 27 mounted atop the inner collector shell 15, the upper end of the shell being closed by a sealing disc 28. Water from the distributor is supplied through radially extending pipes 29 to an outer water ring 30 lying above the mounting ring 19 and provided with passages 31 which conduct the water to distribution channels formed in a circular flange 32. Flange 32 lies against the inner surface of the outer shell 16 and acts to supply water therein in a manner producing thereon an evenly distributed film of downwardly flowing water.

Water from the distributor 27 is also fed to a water ring 33 connected to the upper end of the inner shell 15 and having a passage 34 therein which supplies the water to the

distribution channels formed in a circular flange 35 which lies against the outer surface of the inner shell 15 in a manner also producing an evenly distributed film of downwardly flowing water.

The structure of the water distribution flanges can best be seen in Figs. 4, 5 and 6 which show the circular flange 35 for the inner shell in a straight line projection. It will be seen that formed on the surface of the flange is an array of equi-spaced tapered ribs 36 which are all inclined relative to the vertical to define a series of diverging or flared water channels 37. Water enters the flange from the associated ring at the channel entrances 37*a* and is discharged against the surface of the collector shell at the channel exits 37*b*.

As best seen diagrammatically in Fig. 7, the flow of water through the divergent channels 37 causes the water at the exits thereof to fan outwardly. The diverging patterns from the various channels intersect at a point slightly beyond the exits and the resulting interference prevents build-up of the film and tends to produce an even water distribution along the collector surface. This action is further aided by the whirling motion imparted to the water by reason of the incline of the flange channels, the water thereby entering tangentially and spirally along the collector surface. The combined action of the diverging multiple streams of water and the whirling motion of the stream has been found to result in a uniform water film which adheres to the surface of the collector and avoids the presence of dry spots thereon. The flanges may in practice be made of rubber, nylon or similar material.

Attached to the lower end of inner collector shell 15 is a base ring 36 and attached thereto is a circular gutter 38A, the gutter being interposed between the upper end of conical deflector 25 and the lower end of the inner shell 15 so as to receive the downwardly flowing water therefrom. Positioned at lower end of shell 16 is an annular trough 38,

the inner wall of the trough extending above and being spaced from the lower end of the outer shell 16 to receive the water flowing downwardly thereon. Suitable pipes 18 are provided (not shown) to return the water received in gutter 38A and trough 38 to the tray well 13 for recirculation. Thus continuous water films are produced in both collector shells.

Supported above the water distributor 27 and insulated therefrom is a conductive spider ring 39 from whose radially extending horizontal arms 40 are vertically suspended a group of wire precipitator or discharge electrodes 41, the wire electrodes lying midway between the inner and outer shell in the air passage 17. Pre-ionization electrodes (not shown) may be attached to the lower end of the precipitator electrodes. A suitable high-voltage power supply 42 may be housed within the space provided within the inner shell, or it may be mounted adjacent the motor 20 at the top of the cabinet.

The high voltage supply is constituted by any known high voltage generator whose negative terminal is connected to the water pool and whose positive terminal is connected to the precipitator electrodes. As the water is pumped continually by the pump and allowed to fall uniformly down the collector surfaces, the potential applied to the pool by the supply will also be applied to the water films or curtains on the collectors. Thus an electrostatic field is established between the electrodes and the two fluid collector surfaces on the walls defining the annular passage 15.

The precipitator shown is capable of cleaning the air in a large enclosure, the air being drawn in through the intake grills and being conveyed through the air passage between the collector electrodes. Water sucked up from the pool is caused to flow in a tubular curtain down the collector shells, the contaminating particles being precipitated and washed down the collectors and being received in the pool. Suitable filters are provided in conjunction with the

pump to prevent the return of the particles to the collectors. The air is expelled horizontally and omnidirectionally through the exit grills. It will be obvious that essentially the same system may be used for any cleaning application and the intake may be any form of contaminated gas.

In the electrode system shown in the above-noted figures, the precipitator electrodes may be provided with discharge needles or points to effect pre-ionization of the gas entering the passage. The electrodes are of relatively large diameter whereas the needles are of smaller diameter and have sharp edges to provide a sufficiently high voltage gradient to cause ionization and corona discharge. The corona discharge acts to ionize the particles, such that when they enter the electrostatic field they will be caused to migrate toward the collectors.

To effect power economy, there is provided an electrode arrangement as shown in Fig. 8, wherein precipitator electrodes 50 supported from a ring 51 are connected to a source of direct-voltage 52 which generates a constant voltage, say in the order of 15,000 volts. Suspended below the electrodes 50 by a ring 53, and insulated from the electrodes 50, are circumferentially-arranged corona producing discharge points 54 to which are applied periodic pulses having a magnitude in the order of 30,000 volts. The periodicity of the pulses may be in the audio range or higher.

Since the duty cycle of the pulses is relatively brief, the integrated amount of current drawn is fairly low despite the high voltage. Thus the particles in the air entering the structure are first ionized by the high potential pulses and the ionized particles are then caused to migrate by the precipitator electrodes which need not operate at so high a potential. For purposes of ionization, a constant voltage is not essential since once ionization occurs no useful purpose is served by the ionization field.

The pulse generator 55 may be of any known design, such as is used in radar techniques, and may include differentiating networks or other pulse shaping means.

An alternative electrode structure is shown in Fig. 9, wherein the discharge electrode for creating corona effects is constituted by a series of rings 56 of relatively fine wire which girdles the group of precipitator electrodes 50. In practice, the electrodes 50 may be of a 1/16 inch diameter and the rings of much finer diameter, such as 8 mil wire. The corona producing discharge points employed in the structure of Fig. 8 may be used in conjunction with the wire rings for increased effectiveness. In this case, the same voltage is applied to both sets of electrodes and for this purpose a D.C. supply 57 is provided which is modulated by a modulator 58 to provide pulses superimposed over a constant voltage of the D.C. supply. Thus, as shown in Fig. 10, the pulses 59 are developed above the D.C. level 60, the pulse peak being twice the D.C. level.

In the embodiment shown in Fig. 9, the number of rings used and the spacing thereof are dependent on the velocity of the gas stream and the frequency of the high voltage pulses in the power supply. Thus, as the frequency of the high voltage pulses increases, the number of rings may be decreased, one ring being sufficient at frequencies of the order of 1000 cycles and greater. Increasing the gas handling capacity of the precipitator by increasing the velocity of the gases passing therethrough will necessitate using a larger number of rings to ensure the ionization of substantially all of the particles carried by the gas stream.

Fig. 11 depicts a schematic diagram of a high voltage pulse generator suitable for use with the precipitators herein described. High voltage supply 61 is employed to produce two D.C. voltages of different magnitudes. Supply 61 embodies a quadrupler 62 and a doubler 63 producing outputs which are related by a factor of two.

The output of doubler 62 is connected to curved contact 64. The output of quadrupler 63 is connected to curved contact 65. The inner surfaces of contacts 64 and 65 lie along an imaginary circle whose center is at point 66. Wiper 67 is rotated about point 66 by variable speed motor 68. Wiper 67 may be connected by lead wire 69 to an electrical device utilizing pulsating high voltage, such as for example the electrostatic precipitators of this invention.

The rotation of wiper 67 produces essentially a square wave voltage which fluctuates between the level of the output of the doubler 62 and the level of the output of the quadrupler 63. It is necessary to confine contacts 64 and 65 and wiper 67 in such a manner as to prevent sparking. This may be accomplished by submerging the parts in a high dielectric liquid, or, alternatively by enclosing the parts in a chamber which may be maintained at a high gas pressure.

The frequency of the output voltage is controlled by the speed of rotation of wiper 67. The duty cycle is fixed by appropriately choosing the relative circumferential lengths of contacts 64 and 65.

Other pulsating high voltage systems may also be employed in conjunction with the electrostatic precipitators of the present invention. Thus for example, instead of the contact and wiper arrangement shown in Fig. 11, either a mechanical chopper or an electronic control utilizing gas tubes as electronic gate selectors are suitable.

Fig. 12 shows a sectional view of a portion of inner collector shell 15 and outer collector shell 16. In the preferred embodiment shown in Fig. 12 the outer surface of shell 15 and the inner surface of shell 16 are coated with a porous ceramic, such as, for example, alumina. It has been determined that use of such a porous coating 70 facilitates the formation of a thin, uniform liquid film which is essential in order to achieve high efficiency.

While there has been shown what are considered to be embodiments of the invention, it will be manifest that many changes and modifications may be made therein without departing from the essential spirit of the invention. It is intended, therefore, in the annexed claims to cover all such changes and modifications as fall within the true scope of the invention.

Allowed Claims

21. An electrostatic precipitator as set forth in claim 20, wherein said inlet means includes means to admit said gas in a horizontal plane and further includes a frusto conical deflector in axial alignment with said tubes to direct contaminated gas entering in the horizontal plane upwardly through the vertically disposed conical passage, and wherein said outlet means includes an inverted frusto conical deflector in axial alignment with said tubes to direct the clean gas from said passage outwardly in the horizontal plane.

23. A precipitator as set forth in claim 20, further including a high voltage supply disposed within said inner tube to produce said high voltage.

25. A precipitator as set forth in claim 20, wherein said means to produce a downwardly flowing liquid film on said inner and outer tubes includes a distributor flange coupled to the upper end of each tube and provided with diverging water channels inclined to direct water in a plurality of diverging streams tangentially against the tube surface, which streams intersect on the surface to form said substantially uniform water film thereon.

26. A precipitator as set forth in claim 25, wherein said flange is provided with ribs which bear against the surface of the tube to produce said inclined water channels.

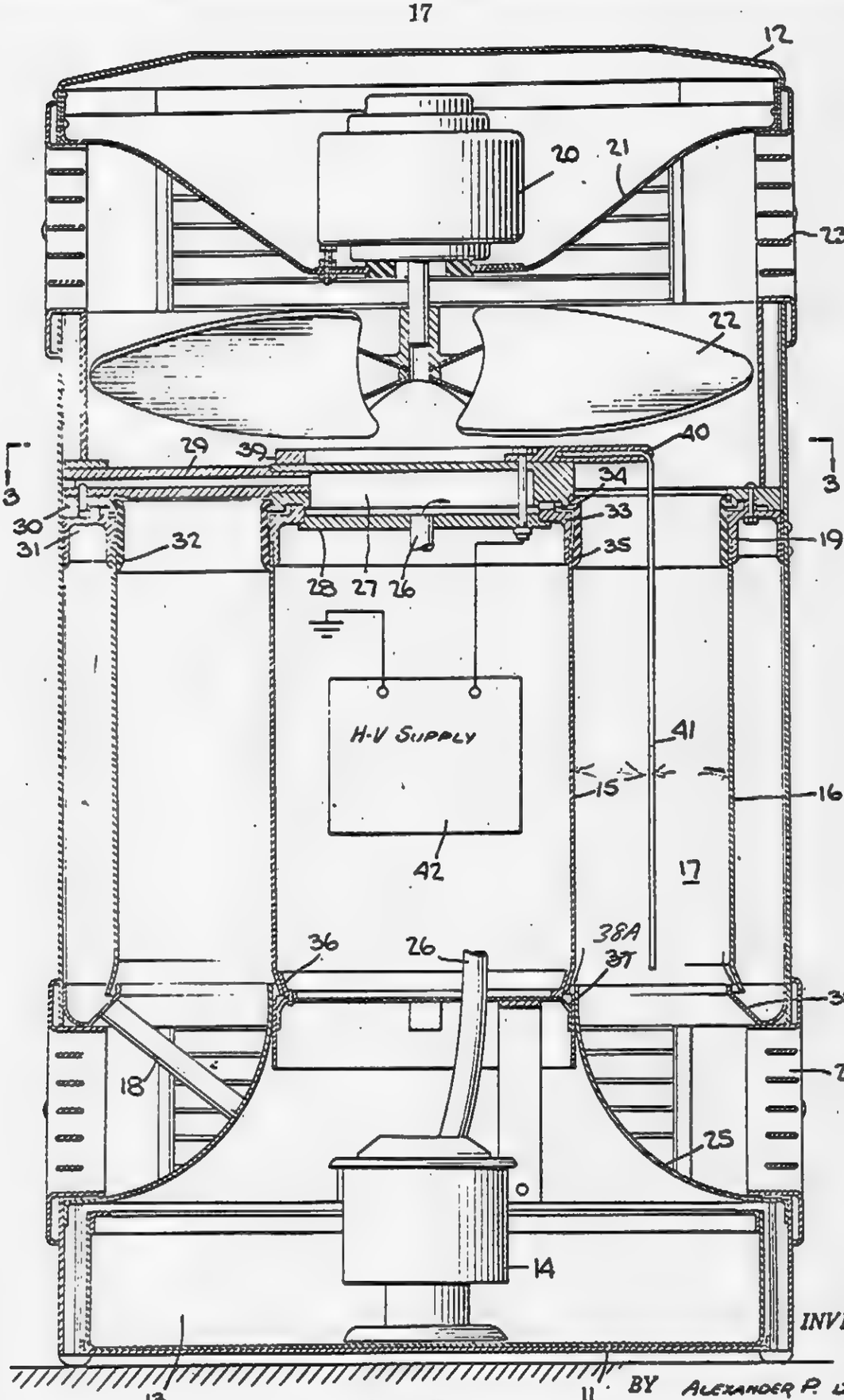


Fig. 2.

INVENTOR.

BY ALEXANDER P. DE SEVERSKY

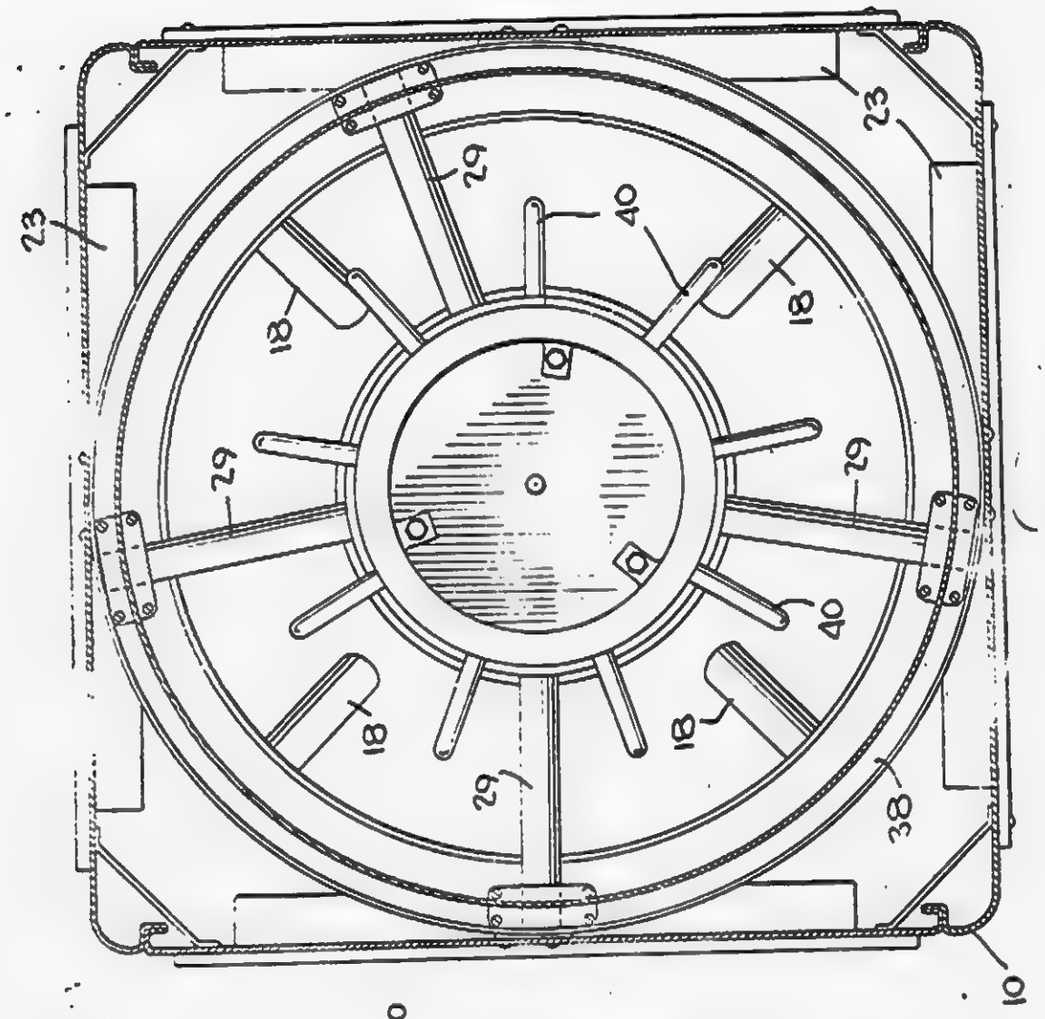


Fig. 3.

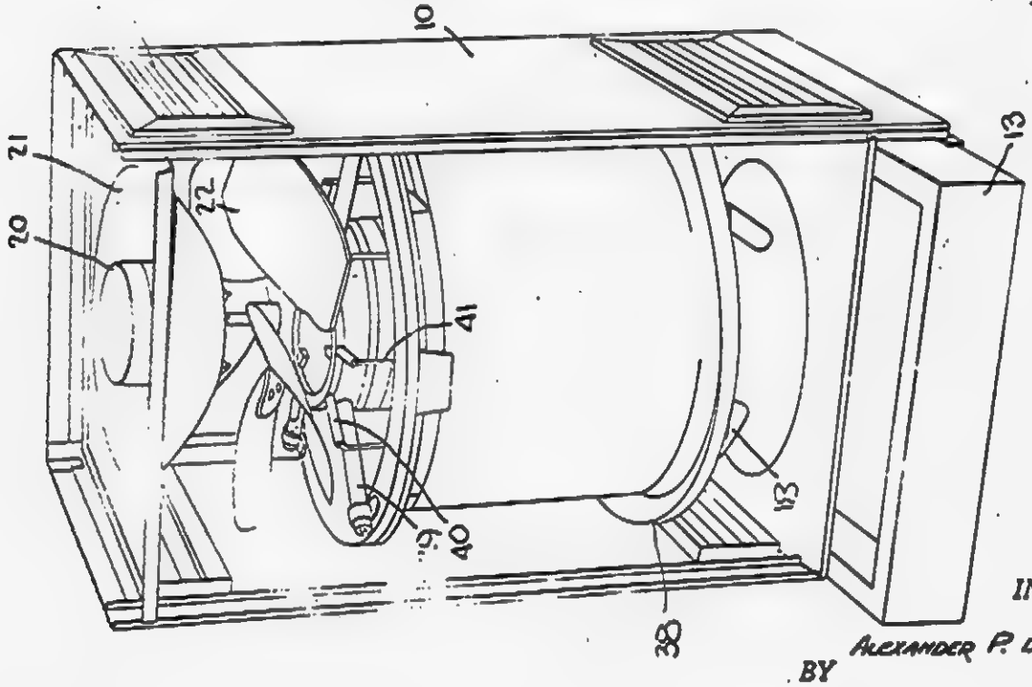


Fig. 1.

INVENTOR.
ALEXANDER P. DE SEVERSKY
BY

ATTORNEYS

Fig. 4.

Fig. 5.

Fig. 7.

Fig. 6.

INVENTOR.
ALEXANDER P. DE SEVERSKY

BY

ATTORNEYS

Fig. 8.

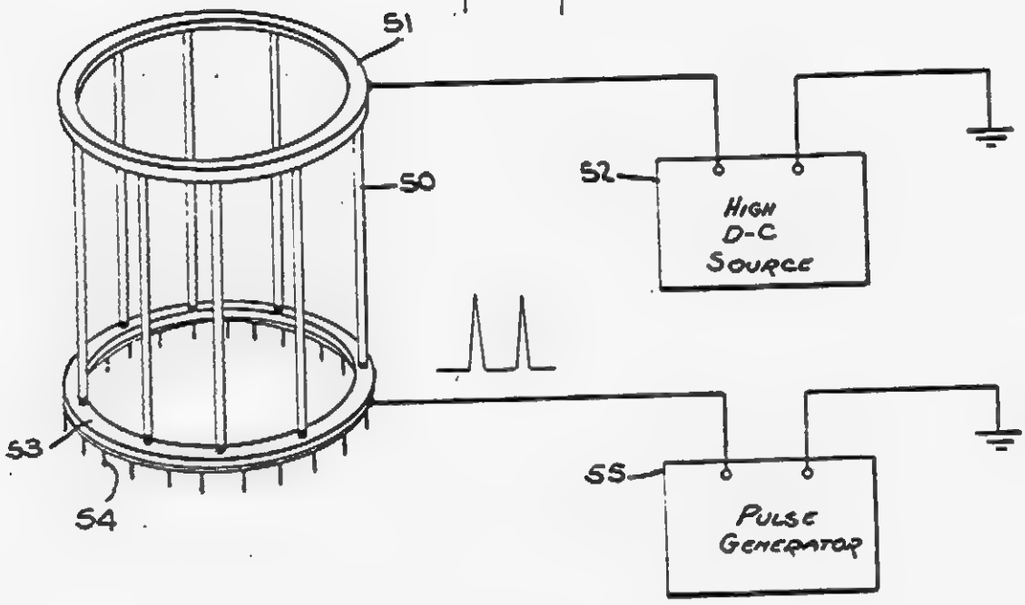


Fig. 9.

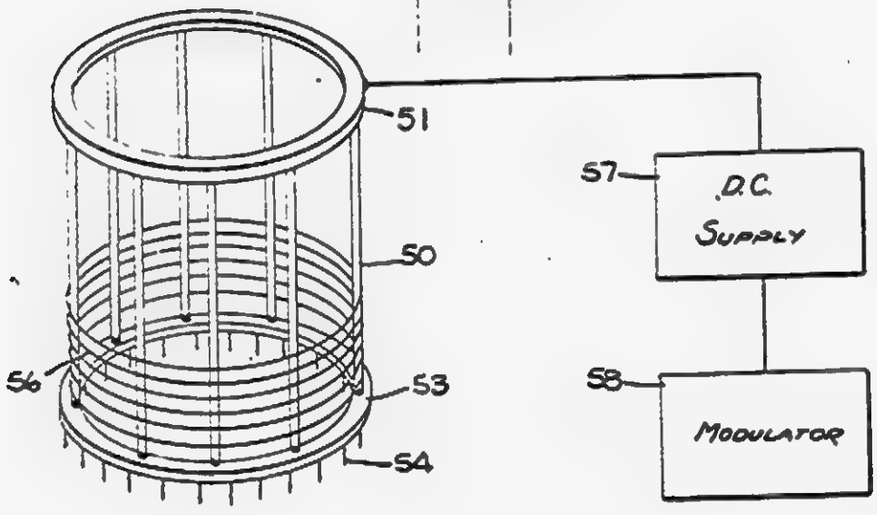
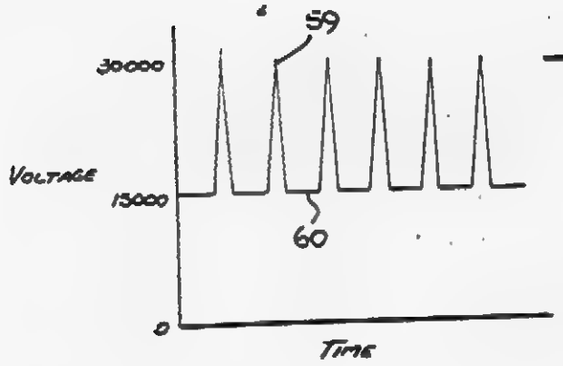


Fig. 10.



INVENTOR.
ALEXANDR P. DE SEVERSKY

BY

ATTORNEYS

Fig. 11.

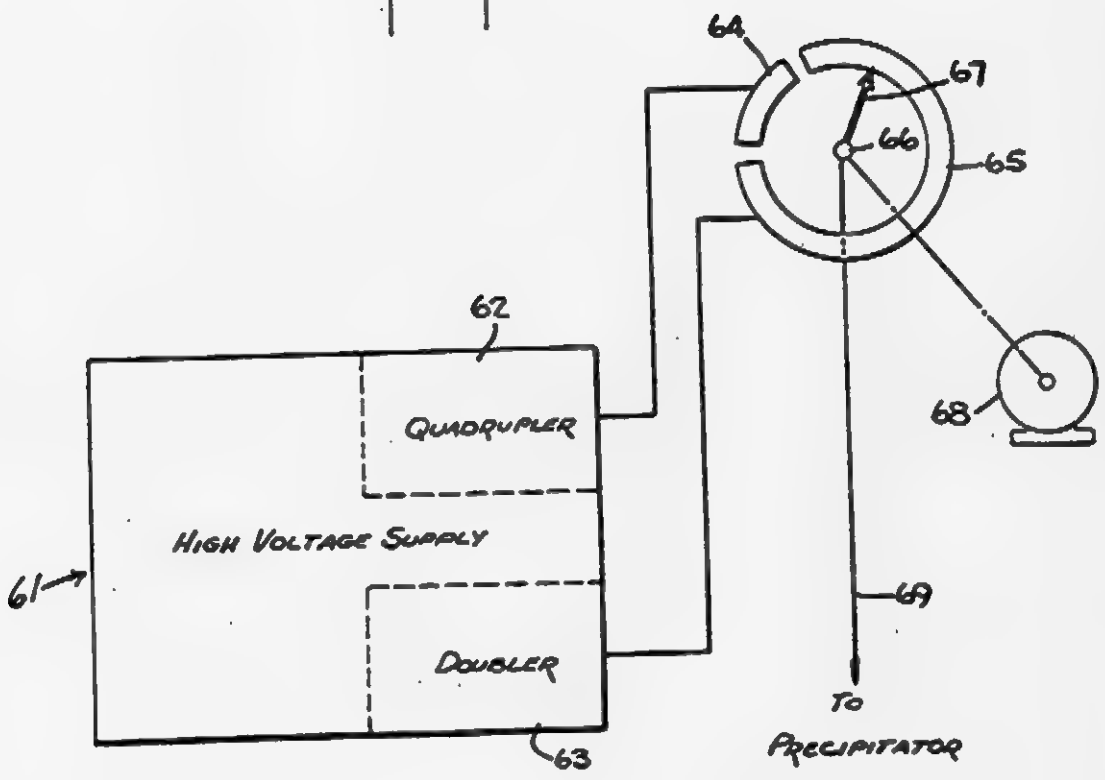
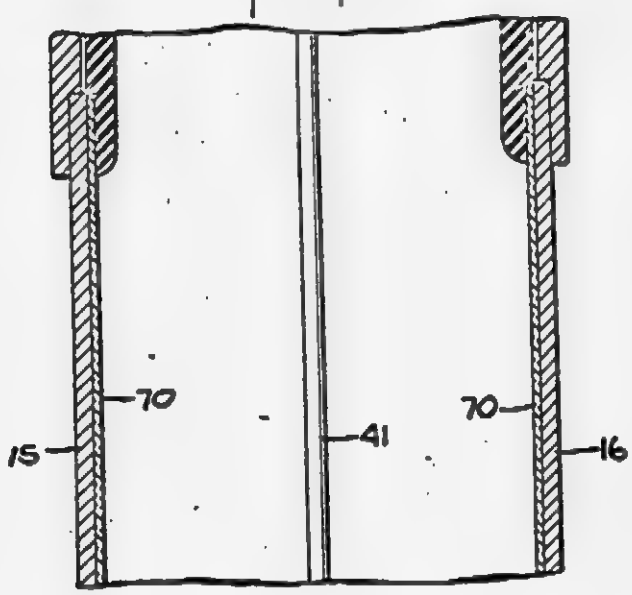


Fig. 12.



INVENTOR.
ALEXANDER P. DE SEVERSKY

BY Kenyon & Kenyon

ATTORNEYS

Claim on Appeal

20. An electrostatic precipitator for cleaning contaminated gas comprising: ..

(A) concentrically-arranged inner and outer collector tubes defining a vertically disposed annular gas passage,

(B) means coupled to a well to draw liquid therefrom and to feed the liquid to the upper ends of said tubes to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage,

(C) concentrically-arranged troughs at the lower ends of said tubes to receive the downwardly flowing liquid therefrom and to discharge the liquid into said well,

(D) inlet means to introduce said contaminated gas into the lower end of said annular passage between said troughs,

(E) a discharge electrode structure supported within said passage,

(F) means to apply a high voltage between said discharge electrode structure and both of said tubes to cause migration of particles in said gas toward the films on said tubes and thereby produce a clean gas, and

(G) outlet means at the upper end of said annular passage to discharge the clean gas into the atmosphere.

IN THE UNITED STATES PATENT OFFICE
BEFORE THE BOARD OF APPEALS

Appeal No. 570-36

Applicant: ALEXANDER P. DESEVERSKY
Serial No. 53,255
Filed August 31, 1960
For: WET ELECTROSTATIC PRECIPITATOR
Group 180

Brief on Appeal

Before considering the references, it may be helpful to point out how parent claim 20 is supported by the drawing. Claim 20 calls for:

(A) *concentrically-arranged inner and outer collector tubes defining a vertically disposed annular gas passage,*

(The concentric tubes [note Fig. 2] 15 and 16 form the annular gas passage 17)

(B) *means coupled to a well to draw liquid therefrom and to feed the liquid to the upper end of said tubes to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage,*

(The uniform films of liquid on the tube surfaces are produced by water flange 35 for the inner tube 15, and water flange 32 for the outer tube 16, the water being drawn from well 13.)

(C) *concentrically-arranged troughs at the lower ends of said tubes to receive the downwardly flowing liquid therefrom and to discharge the liquid into said well,*

(The trough or gutter 37 is for the inner tube and the trough 38 concentric therewith is for receiving water from the outer tube, the troughs returning the water to the well 13).

(D) *inlet means to introduce said contaminated gas into the lower end of said annular passage between said troughs,*

(The inlet is defined by conical deflector 25 which feeds gas upwardly into the gas passage between the troughs 37 and 38).

(E) *a discharge electrode structure supported within said passage,*

(Electrode 41 is the discharge electrode in the gas passage 17).

(F) *means to apply a high voltage between said discharge electrode structure and both of said tubes to cause migration of particles in said gas toward the films on said tubes and thereby produce a clean gas,*

(H-V supply 42 is connected between the electrode 41 and the collector tubes.)

(G) *outlet means at the upper end of said annular passage to discharge the clean gas into the atmosphere.*

(The outlet is defined by the inverted conical deflector 21.)

U. S. DEPARTMENT OF COMMERCE
PATENT OFFICE
Washington

BEFORE THE BOARD OF APPEALS

Appeal No. 570-36

In re application of
ALEXANDER P. DE SEVERSKY
Ser. No. 53,255
Filed August 31, 1960
For WET ELECTROSTATIC PRECIPITATOR

MICHAEL EBERT for Appellant

Examiner's Answer

This is an appeal from the final rejection of claims 20 through 27. The amendment under Rule 116, submitted June 11, 1965, has been entered. The amendment cancels claims 22, 24, and 27. Upon reconsideration claims 23, 25, and 26 are allowed. The claims to be considered on appeal are, therefore, claims 20 and 21.

The copy of the appealed claims appearing on pages 2 through 3 of appellant's brief is correct except that in claim 21, line 2, "include" should be—includes—.

The references of record relied on are:

1,250,088	12-1917	Burns
1,357,202	10-1926	Nesbit
2,448,046	8-1948	Penney et al.

The invention is adequately described in pages 3 through 7 of appellant's brief.

THE REFERENCES

Nesbit shows, in Figure 16, inner tubular collecting electrode 51, outer tubular collecting electrode 31 and dis-

charge electrode 34 disposed in the annular passage between collector electrodes 31 and 51. As can be seen in Figure 16 there is an annular collector trough at the bottom of each collector electrode. Gas enters at the bottom, passes upwardly through the annular channel formed by collector electrodes 31 and 51 and then out the top of the precipitator. The annular trough below collector electrode 51 has a frusto-conical portion. The upper end of the collector electrode 31 has a frusto-conical portion which is inverted with respect to the frusto-conical portion in the collection trough below collector electrode 51.

Burns shows collector tubes 1 with a liquid film thereon. The film is produced by elements 10. Elements 3 are discharge electrodes. In Figure 4 Burns shows an annular collection trough comprising elements 17 and 19. In page 3, column 2, lines 66-71 Burns discloses continuously supplying the liquid to the collector electrode, and in page 2, column 2, lines 124 to 127 Burns discloses that the liquid forms a "smooth, even surface" and prevents concentration of the electric field at any point.

Penney et al. show collector electrodes 22 which are wetted with liquid without deenergization of the electrically charged electrodes 12 and 20. The wetting liquid flows into troughs 74 and 76, through pipes 78 and 80 and into well 82. The liquid in well 82 is pumped via conduit 100, pump 98, and conduit 102 back to the liquid distributing means to be again distributed over the surfaces of collecting electrodes 22 (see column 7, lines 33-72).

The Rejection

Claims 20 and 21 are rejected as being unpatentable over Nesbit in view of Burns and Penney et al. under 35 U.S.C. 103. Nesbit (Fig. 16) meets the limitations of said claims with the exception of showing a means to produce a liquid film on the collecting surfaces of collecting electrodes 31 and 51 and a means to recirculate the liquid. The patent

to Burns is relied upon to show that it is an obvious expedient in the art to wet the collecting surface of tubular collecting electrodes to prevent concentration of the electric field at any point (see page 2, column 2, lines 124 to 127) and to wash the precipitated material from the collector electrode surface (see page 2, column 2, lines 128-130 and page 3, column 1, lines 1-2). The patent to Penney et al. is relied upon to show that it is an obvious expedient in the art to collect the wetting liquid draining off of wet collector electrodes in troughs, to deliver the liquid from the troughs to a well, and to deliver the liquid from the well to the top of the collector electrodes so that the liquid may be redistributed over the collector electrode surfaces. It would, therefore, be obvious to one having ordinary skill in the art to employ these teachings in the device of the Nesbit reference by, for example, providing a well into which the Nesbit concentric annular collection troughs discharge, and providing a means to pump the liquid from the well to the top of the collecting electrodes 31 and 51 and distributing liquid over the surfaces of said collecting electrodes. Additionally as to claim 21, it is noted that Nesbit shows a lower frusto-conical deflector as a portion of the collection trough below collector electrode 51 and a frusto-conical deflector, inverted with respect to said lower frusto-conical deflector, at the upper end of collector electrode 31. Furthermore, claim 21 appears to be misdescriptive in that the term "vertically disposed conical passage" apparently should be—vertically disposed annular passage—.

In order to simplify the issues on appeal the Buff, Hodson et al., Shaffner, and Nelson et al. references are no longer relied upon and the rejection of claims 20 and 21 as failing to comply with 35 U.S.C. 112 is withdrawn. In respect to the rejection under 35 U.S.C. 112 the indefinite portions of the claims are considered to be adequately treated above in the application of the prior art to claims 20 and 21.

Response to Appellant's Arguments

Appellant's arguments have been carefully considered but are not deemed to be persuasive that claims 20 and 21 patentably distinguish over the prior art as applied above. In page 8 of the brief appellant argues the features which allegedly lend patentability to appellant's device over the device of Nesbit. In this regard it is respectfully submitted that the use of uniform films of downwardly-flowing liquid formed on the collecting surfaces of collector electrodes is a notoriously old and an obvious expedient in the art as can be seen by reference to Burns. To supply the liquid to the upper end of the collector electrodes from a well, positioning troughs at the lower end of collecting electrodes for receiving liquid therefrom, and for discharging the liquid into said well is an old and obvious expedient in the art as can be seen by reference to Penney et al. Therefore the features of appellant's claims 20 and 21 which appellant cites as patentably distinguishing over the device of the Nesbit reference are all features which are old in the art, obviously taught by the references of record, and features, therefore, which would be obvious to one having ordinary skill in the art. These features are applied in the combination for their known teachings, and function in the combination in the same manner.

For the foregoing reasons it is respectfully submitted that claims 20 and 21 are unpatentable over the prior art and that the final rejection of said claims should be sustained.

Robert F. Burnett
Examiner

DTalbert:jw

BNozick (Conferee)

WO 7-3853

Michael Ebert
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Group 180 Paper No. 20

Appeal No. 570-36

IN THE UNITED STATES PATENT OFFICE

BEFORE THE BOARD OF APPEALS

Ex parte Alexander P. De Seversky

Application for Patent filed August 31, 1960, Serial No. 53,255. Wet Electrostatic Precipitator.

Michael Ebert for appellant.

Before Friedman, Kreek and Keely, Examiners-in-Chief. Friedman, Examiner-in-Chief.

This appeal involves claims 20 and 21. Claims 23, 25 and 26 have now been allowed, and the appeal as to these claims is therefore dismissed.

We will read the word "conical" at line 5 of claim 21 as if it were *annular*, in accord with the comments of both appellant and the Examiner in this respect.

The references relied on are:

Burns	1,250,088	Dec. 11, 1917
Nesbit	1,357,202	Oct. 26, 1920
Penney et al.	2,448,046	Aug. 31, 1948

We note an error in the Answer as to the date of the patent to Nesbit. Its correct citation is as given above.

Claims 20 and 21 have been rejected under 35 U.S.C. 103 as unpatentable over the patents cited above, of which that to Nesbit is applied as the primary reference.

We have carefully considered the arguments advanced by appellant, in both his main and reply briefs, but are of the opinion that claim 20 presents nothing patentable over the prior art. In reaching this conclusion, we prefer to

rely on Burns as the primary reference, as being the most suitable for the purpose.

Burns discloses the concept of a wet precipitator utilizing a flowing liquid film as an electrode to be old, and that portion of the patent from line 124 of page 2 to line 3 of page 3 describes said film as having such inherent surface tension as to maintain "a smooth, even surface". This would in our opinion reasonably denote a film of "substantially uniform" character, as recited in the claim.

While Nesbit relates to a dry rather than a wet precipitator, nevertheless this patent embraces a broad teaching of an annular gas flow passage for precipitator devices in general. We think that it would constitute merely an obvious following of such teaching of the prior art to modify the Burns device to provide the same with a gas flow passage of annular rather than purely cylindrical configuration. Burns presently shows troughs 16 for collecting and discharging the liquid films, and upon the modification involved concentric troughs one for each tubular film would be logically expected.

We are in agreement with the Examiner that the patent to Penney et al. would broadly teach the expedient of recirculating the liquid used in a wet precipitator, and inasmuch as this patent was applied only for this purpose, we are not impressed by appellant's arguments under the subheading "*Point IV*" in his reply brief.

For the reasons given, as well as those not inconsistent therewith set forth in the Examiner's Answer, we will sustain the rejection of claim 20.

However, we will not sustain the rejection of claim 21. This claim depends from claim 20 and adds thereto certain details of the gas inlet and outlet means. Even though Nesbit may show frusto-conical shaped parts, they are not gas flow directing elements having geometrical configura-

tion and relation as recited in the claim. Nor do we find such elements to be disclosed by either of the other references relied upon by the Examiner.

The decision of the Examiner is affirmed as to claim 20, but is reversed as to claim 21.

AFFIRMED-IN-PART

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[3] TRANSCRIPT OF PROCEEDINGS

The Deputy Clerk: Alexander P. DeSeversky versus Edward J. Brenner, Civil Action 2344-66.

Mr. Dent: Your Honor, I would like to move the admission of Mr. John Calimafde and Mr. Michael Ebert, both members of the Court of New York, to try this case.

The Court: That may be done pro hac vice, of course. We would like to have them as permanent members, but that can't be done.

Mr. Calimafde: Mr. Ebert is out of the room at the moment. Mr. Dent just introduced Mr. Ebert to Your Honor. He is presently out of the room.

The Court: I did that on faith. All right. Thank you.

Mr. Calimafde: Your Honor, shall I assume a familiarity with the subject matter—

The Court: You had better not assume. I made a cursory glance at it because I didn't have the opportunity.

(Remarks off the record.)

The Court: All right. Go ahead.

Mr. Calimafde: As Your Honor knows, this is a 145 proceeding involving one claim in a patent application in which all of the other claims have been allowed by the Patent Office.

[4] The claim is directed to an electrostatic precipitator. Now, an electrostatic precipitator is simply a kind of device for removing the pollutants from air, and it is a particular kind which I will describe in more detail in a few minutes.

The basis of the Patent Office's rejection is one of obviousness over the prior art. The Patent Office cited three patents. The claim in controversy is a combination claim. The contention by the Patent Office is that one of the prior patents anticipates one element in the claim. A second of the prior patents anticipates a second element in the claim, and a third of the prior patents anticipates a third element.

It is admitted, Your Honor, that the three patents do not anticipate, or the prior art does not anticipate in the context of 35 U.S. 102, the three patents together, taken together, do not meet every element in the claim. The rejection is based on the contention that one skilled in the art upon seeing these three patents, would know how to modify these three patents to construct the invention.

Now, I would like to describe briefly to Your Honor, the claimed invention. It is directed to the electrostatic precipitator, and the electrostatic precipitator is a device which operates on the principle that the contaminants [5] —the particles such as soot, can absorb an electrical charge, and once having absorbed this charge can be passed through a chamber which has an electrical field, the chamber having an apposite type charge—a similar type charge, your Honor, so as to repel these contaminants to a collector type of electrodes, and then these contaminants are cleaned off the electrodes, called the collector electrodes.

Now, the precipitator, which is defined by the claim in this controversy, comprises two cylinders in this prospective view. The outer cylinder is shown, cut away, but with these dot and dash lines, to show how the entire cylinder would look. That is an outer cylinder. The precipitator claimed in Claim 20 includes an inner cylinder. So that between these two cylinders we have a space. In this space there is mounted electrodes. The electrodes are shown as a vertical line extending downwardly, but joined at the top to a high voltage source.

The Court: To a what?

Mr. Calimafde: High voltage source. These electrodes have a high—they are called discharge electrodes, Your Honor. They have a high voltage. The inner and outer cylinder are at ground potential, so there is a stronge voltage between the electrode and the opposite surface of the cylinders.

[6] The Court: That is a term of art. You will have to make it more specific to me—ground potential.

Mr. Calimafde: It is connected to a lower potential than the higher voltage, and often the potential which is considered a basic reference potential they refer to as ground —a radio chasis for example, Your Honor, is called a ground potential.

Because of the voltage difference between the electrodes and these opposing cylinderical surfaces, there is a strong electric field in this space.

The Court: Now, when you say the "space," you mean space between the inner cylinder circumference and the outer cylinder circumference.

Mr. Calimafde: Yes, Your Honor. The claim also defines that the outer cylinder and the inner cylinder, the facing surfaces, will have a continuous film and a uniform film of water continuously flowing downwardly, down these two surfaces. The purpose in having the water flow downwardly is to wash continuously the contaminants which collect on the surfaces of the two cylinders.

The water which drains off the cylindrical walls, drain into a reservoir at the bottom and, not shown in this perspective view, is carried to a pan and then pumped again back [7] to the top and permitted to flow down the walls of the cylinders.

In the language of the claim, to translate the claim into language which is understandable, we call for an electrostatic precipitator for cleaning contaminated gas comprising concentrically arranged inner and outer collector tubes. The inner is the one shown as a cylinder at the inside. The outer is the one I mentioned previously. Defining a vertically disposed annular gas passage. And annular is simply a doughnut-shaped space, Your Honor, and the annular passage is a passage between—

The Court: A-n-n-u-l-a-r?

Mr. Calimafde: Yes.

The Court: That is Latin for worm.

Mr. Calimafde: Annulus, yes, Your Honor.

The Court: What is the use of it here, again, you say?

Mr. Calimafde: The word "annular" means doughnut-shaped.

The Court: Doughnut-shaped. All right. Go ahead.

Mr. Calimafde: Patent attorneys have a tendency to adopt words like "annular" and—

The Court: That is a good way of doing business. It is more descriptive. All right. Go ahead.

Mr. Calimafde: So the annular gas passage is [8] that passage between the two cylinders, means coupled to a well to draw liquid therefrom.

The well is below what is shown in this drawing. The well contains the water. The means coupled to the well to draw liquid therefrom, and to feed the liquid to the upper end of said tubes.

The Court: Do I understand that the liquid goes down into the well and then comes up again and repeats the process?

Mr. Calimafde: That is right. So it is a recirculating type system where the water is drawn from the well, pumped to the top of the tubes, and applied in a certain manner to each of these tubes.

The Court: Circulating pump arrangement somewhat like that you see in the garden fountains, the water constantly is going up—

Mr. Calimafde: That is it, Your Honor. To produce a downwardly flowing and subtsantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage.

That simply means that the water which is applied to the top of the outer and inner tubes flows downwardly with a uniform film of water covering the entire surface of the [9] outer cylinder and the inner cylinder. So it is completely washed, Your Honor.

But it is important that the downwardly flowing film, be a uniform liquid film, as we shall demonstrate during the testimony of the witnesses.

Concentrically-arranged troughs at the lower ends of said tubes. The concentrically-arranged troughs are shown at "C" at the bottom of the two tubes.

To receive the downwardly flowing liquid therefrom and to discharge the liquid into said well.

From these troughs there is a discharge passage to the well which is not shown in that drawing, but simply would be a pipe, Your Honor, from the trough going into the well.

The Court: And the liquid carrying the contaminants with it.

Mr. Calimafde: Yes.

The Court: And they are deposited in the well, and from there go some other place—

Mr. Calimafde: Down, and the water is recirculated.

Inlet means to introduce said contaminated gas into the lower end of said annular passage between said troughs.

Now, the inlet means to introduce is not shown in details in this drawing, but it is represented by the red arrows. [10] It would be at a location between this passage and the gas simply enters into the space as shown or suggested by the red arrows.

The Court: This is Claim 20.

Mr. Calimafde: This is Claim 20.

The Court: Now, in general, what is the other situation from the standpoint of the invention-in-chief?

Mr. Calimafde: The claims which have been allowed?

The Court: Yes.

Mr. Calimafde: The other claims define mechanical detail, Your Honor, such as the specific jets which apply the water, and specific mechanical construction. We are claiming in Claim 20 the broad concept which I shall get to in just a moment, Your Honor, when I discuss this prior art.

The discharge electrode structure we mentioned previously is constituted by these vertical rods.

Means to apply a high voltage between said discharge electrode structure and both of said tubes to cause migra-

tion of particles in said gas toward the films, that is the liquid film, Your Honor, on said tubes, and thereby produce a clean gas.

These dots in the drawing represent the contaminants [11] in the gas. These contaminants would migrate towards either the outer cylinder or the inner cylinder, depending on which cylinderical surface is closer to the contaminants.

The Court: What is the nature of the gas?

Mr. Calimafde: It is just polluted air, air from incinerators, or a utility company.

Outlets means at the upper end of said annular passage to discharge the clean gas into the atmosphere.

And, again, we have represented the air by red arrows, and clean air emerges from the top of this dual cylinderical unit.

The Court: What is the specific use of this invention?

Mr. Calimafde: The specific use is to clean the air, Your Honor. This would be mounted at incinerators, for example, at apartment houses. Could be mounted at chemical plants where the plant is emitting sulphurous type gas into the atmosphere. This would remove soot, removes any solid particularate matter, and they feed into the bottom of this unit the contaminated gas. The contaminants are collected on these cylinderical surfaces and the clean gas emerges from the top and out of the chimney.

Now, I can pinpoint the focus, I believe, sharply, [12] Your Honor, when I discuss briefly the prior patents.

The Court: All right.

Mr. Calimafde: We refer to the type of precipitator here as a dual cylindrical type precipitator, and I believe the—

The Court: That indicates what it is by use of the language "dual." Two cylinders.

Mr. Calimafde: Now, one of the patents cited by the Patent Office is to a person named Nesbit. Nesbit discloses—

The Court: For the record, that is 1,357,202 dated October 26, 1920.

Mr. Calimafde: That is correct, Your Honor.

Nesbit discloses a dry dual cylinderical type precipitator. For purposes of this proceeding we will concede that Nesbit discloses the outer cylinder, the inner cylinder, and the discharge electrodes in the space between the two cylinders. So, insofar as the distinction between Nesbit and the invention at controversy is concerned, the difference is in the application of water to the opposing surfaces on the two cylinders.

The Court: His invention is directed to the same purpose?

[13] Mr. Calimafde: Yes. It is a precipitator for cleaning contaminated air or contaminated gas.

Now, we go a step further, Your Honor. The second patent which is cited by the Examiner—

The Court: Before you leave Nesbit, wherein does Nesbit differ from this? I want to understand that.

Mr. Calimafde: This difference from Nesbit is in the application of water to the inner surface of the outer cylinder and outer surface of the inner cylinder—

The Court: Nesbit uses no water?

Mr. Calimafde: Nesbit is a dry type precipitator.

The Court: And that is the basic distinction. All right.

Mr. Calimafde: All right.

Now, we get to the second patent cited by the Patent Office, which is a Burns' Patent, 1,250,088.

The Court: 1917.

Mr. Calimafde: Yes, Your Honor.

Now, I have a chart of the Burns figure, too, Your Honor.

The Court: Let's do it this way—the clerk has called to my attention that these have not been marked. Chart Number 1 will be marked Number 1 for identification. The [14] invention we are concerned with here, Claim 20.

Mr. Calimafde: Yes.

The Court: And what you now put on the table is the so-called Burns Patent replica, so to speak, of the critical matter we are concerned with, and that would be Number 2 for identification.

All right.

(Plaintiff's Exhibits 1 and 2 were marked for identification.)

The Court: All right.

Mr. Calimafde: The Burns patent discloses a precipitator of the type which is tubular, as distinguished from a dual cylindrical type, Your Honor. It is strictly a tube with an electrode that is located along the axis of the tube.

Now, Burns discloses three tubes in his patent, and for that reason we have shown three tubes in this partial perspective view, Exhibit 2 for identification.

The distinction between Burns and the Claim 20 is that Burns discloses a tube and because he discloses a tube he is not concerned with the problems which arise in connection with the inner cylinder. But Burns does disclose the application of water.

The Court: Very well.

[15] Mr. Calimafde: Burns, Your Honor, has a tube, and we are prepared to make a further concession in order to sharply focus the issue before Your Honor. The Burns tube is similar to our outer cylinder, to our cylinder called "B" in this sketch, Exhibit 1 for identification. And I will repeat that, Your Honor. The Burns tube we will concede is similar to our outer cylinder, and it is similar because Burns discloses the application of water to the inner surface of his tube for the same reason as we use water. Burns applies water in a circular direction, and as we shall prove later, the direction of that water on the surface of the cylinder is most significant.

Now, Burns applies water in a circular direction. The blue arrows are intended to indicate the direction of the water, Your Honor. The blue arrow shown in Exhibit 1 for identification shows the application of water in a circular

direction to the inside surface of the outer cylinder. Exhibit 1 for identification shows a blue arrow to represent the circular direction of water applied to the outside surface of the inner cylinder.

The Court: Wherein do you make the distinction between the two? Burns uses water, you use water in the same fashion.

[16] Mr. Calimafde: Yes. The distinction between Burns and the invention defined by Claim 20 is that Burns does not disclose an inner cylinder and, most important, neither Burns nor Nesbit disclose the application of water to the inner cylinder, or solve all the problems which arise in connection with the application of water to the inner cylinder.

The Court: So by way of recapitulation the difference between Nesbit, Burns and Claim 20 is that Nesbit has no water, and Burns discloses water, but does not disclose the inner cylinder.

Mr. Calimafde: Yes.

Now, the Patent Office, Your Honor, rejected the claim on the ground that it would be obvious to one skilled in the art to take Nesbit, who has two cylinders, and to take the teaching of Burns, who teaches the application of water to the outer cylinder, and, says the Patent Office, it would be obvious to apply water to the inner cylinder of Nesbit, because Burns teaches us to use water on the outer cylinder. Why don't we take that teaching and apply that water to the inner cylinder?

The Court: Why don't we?

Mr. Calimafde: That is the issue before Your Honor. We will prove, Your Honor, that the application of water to the inner cylinder causes and has caused tremendous problems. [17] In a wet type precipitator you cannot tolerate splash or droplets. If there is a splash off the outer surface or the inner surface, you have spark-over, and when you have spark-over you have short circuit and failure of equipment.

So a pre-condition to a wet precipitator is that you cannot tolerate splash or droplets in that space.

Now, in a Burns type tubular arrangement—we shall demonstrate, Your Honor, that when water is applied to an outer cylinder, to the curved surface, which is an inward type curve, and you flow water at an angle to that curve, the water is going to hug that surface. This is the usual centrifugal force phenomena, like throwing a ball around a curved surface. That ball will want to stay on that surface. And when you apply water on the curved surface as in Burns, that water will want to stay on this surface, and they apply that water, Your Honor, but they say tangentially, which means at an angle to that surface. They are applying it as my pen is being directed inwardly to the chart. That is tangentially to the surface.

Because it is applied that way the water will tend to remain on that surface because of what they say, centrifugal forces. When you try to apply water to the surface of your inner cylinder, which is now curved outwardly, that water wants to leave the surface, which I will demonstrate, Your [18] Honor, by simply spinning a ping-pong ball later in the outer cylinder, and that ball will stay along that surface, as a water droplet will, and obviously you cannot spin a ball around the outer surface of the inner cylinder. That ball will want to leave that surface, and that is what the water droplet wants to do. The water wants to leave the outer surface because of its curved shape, and because the water is being applied at a tangential direction, it wants to leave into the space, and if it does you have spark-over and failure.

So, for fifty years, Your Honor, since Burns in 1917, and Nesbit in 1920, industry has been trying to develop a dual cylinder wet precipitator, but there has been no dual cylinder wet precipitator until the invention which is before the Court today. There is no evidence of a dual cylinder wet precipitator simply because of these monumental problems associated with the application of water

applied to the outer surface where the water wants to fly off, and the invention, Your Honor, is the invention defined in Claim 20, which, as we shall demonstrate through witnesses and other evidence, by applying gas in a very particular way, you can now use that gas to force the water which wants to leave the inner cylinder, to force it back onto the surface and prevent flash—

The Court: When we are talking about the surface [19] of the inner cylinder we are talking about the outside surface that relates to the generally larger cylinder.

Mr. Calimafde: We are referring to the outer surface of the smaller cylinder which faces—

The Court: That is right. The inside surface of the outer cylinder.

Mr. Calimafde: That is correct.

The Court: So you say as a consequence of the use of gas that forces the water to take a characteristic it wouldn't take if the gas wasn't used.

Mr. Calimafde: And it is the characteristic of applying the gas in a particular way. If you simply applied gas in the normal way, it would be inoperative, and we shall prove by testimony that for years the inventor and his company applied gas in the usual way and it failed. They were searching for a wet precipitator, as was the industry.

The Court: How was gas applied here?

Mr. Calimafde: In an expanding way, applied through what they call a Venturi (sic) tube. This tube, or opening, is like an hour glass. The gas is forced into a constricted area, which is a necked down area of the hour glass, and that gives the gas a high velocity because you are now trying [20] to push through gas, through a constricted opening. As the gas leaves the constricted neck of your Venturi tube—

The Court: V-e-n-t-u-r-i?

Mr. Calimafde: Yes, Your Honor. And it is simply an hour glass shape, Your Honor.

And as this gas leaves the constricted neck it expands and the expanding gas which enters this chamber now pushes back the water to the respective surfaces, and it was only through this concept of applying an expanding gas to the inlet portion of your chamber—

The Court: In other words, it expands, in the circumstances, and the water that would have a tendency to fall off is forced back upon the surface.

Mr. Calimafde: That is correct, Your Honor.

The Court: On the exterior surface of the inner tube, inner cylinder.

Mr. Calimafde: That is right. And that, precisely, is the issue before Your Honor.

The Court: And the claim of the Patent Office is that would be obvious, the use of the gas in the circumstances here.

Mr. Calimafde: They never came to grips with that particular issue. All the Patent Office has said is that [21] it would be obvious to use the teaching of Burns with the teaching of Nesbit to produce the claimed invention. The Patent Office has never addressed themselves to the specific issue that it would have been obvious to have conceived, Your Honor, of the expanding gas as the means for pushing back the water to the respective surfaces.

The Court: And Nesbit's dry dual cylinder, and no water, and Burns uses water.

Mr. Calimafde: There is no mention in either patent of the problem or how to solve it.

The Court: All right.

Now, you made your presentation of what you intend to prove.

Mr. Calimafde: Yes, Your Honor.

The Court: Mr. Nakamura, how about that? Do you agree with that, that is the issue?

Mr. Nakamura: Your Honor, may I hand up at this time Defendant's exhibit?

The Court: That is Number 1 marked for identification.

Are you proffering it in evidence now?

Mr. Nakamura: If Your Honor wishes, I will.

The Court: We will take the others in evidence, too.

[22] Mr. Calimafde: We will offer the two charts as Plaintiff's Exhibits 1 and 2, and while we are talking about Plaintiff's Exhibits, this is a certified copy of the application.

The Court: Number 3.

And the actual proceedings before the Patent Office, that is, rather, the Examiner of the Board of Appeals, Exhibit Number 1 in evidence.

Mr. Nakamura: Yes, Your Honor. Thank you.

(Plaintiff's Exhibits 1, 2 and 3 were received in evidence.)

Mr. Calimafde: Your Honor, I have a memorandum of law, since I am offering things. I handed a copy to Mr. Nakamura.

The Court: Let's get Mr. Nakamura's observation with respect to what you have said, what counsel has said in relation to what is before me.

Mr. Nakamura: May it please the Court, the counsel for plaintiff has pointed out that the Patent Office has relied upon the Burns patent, the Nesbit patent, and in addition I would like to point out a third patent has been relied on by the Patent Office.

The Court: That is the Penny patent, 2,448,046. That is a 1945 patent. He didn't allude to that.

Mr. Nakamura: No. That patent relates to means [23] of circulating a liquid through an electrostatic precipitator plate. Apparently he doesn't contest the point, but it does disclose this recirculating means, and if Your Honor is satisfied that that is so, I will not dwell—

The Court: I don't know, but I am assuming by what was said by counsel for the plaintiff that the basic patents, the critical patents, are Nesbit and Burns—

Mr. Nakamura: Yes, that is correct.

The Court: And with Penny as a sort of corollary, so to speak.

He also raised the point that the issue before me is the distinction between Nesbit and Burns and, again, by way of repetition, that Nesbit consists of a dry dual cylinder, and no water, and that Burns is tubular, and is not concerned with an inner cylinder, and does not disclose an inner cylinder and, in addition to that, cannot tolerate—or, rather, that is the picture then as a consequence of what he said with relation to Burns, and that Burns does not use gas, and the use of gas is not alluded to at all by the Patent Office in rejecting the claim; isn't that right?

Mr. Nakamura: I believe in one respect I would differ with that statement, and that would be that Burns does use gas. The Burns is a precipitator for cleaning gas.

[24] The Court: Burns is a precipitator for cleaning gas, but he doesn't use gas in the sense in which this claim here uses gas.

Mr. Nakamura: No, Your Honor—

The Court: What I am trying to do is focus the matter before myself so that when I get back to chambers next week, or so, when I start reading this business I will know what I am talking about, and I will know what you had in mind.

Mr. Nakamura: I agree with counsel, his interpretation of Nesbit. I agree with counsel on his interpretation of Burns, and by that I mean this: that Burns discloses a tubular member which is washed with water and through which gas passes.

The Court: He is not concerned with an inner cylinder.

Mr. Nakamura: He is not concerned with a second cylinder within the other cylinder.

The Court: And does not disclose the application of water.

Mr. Nakamura: For that other cylinder, that is correct. That I agree to.

Now, counsel pointed out that the issue here is the application of water to that inner cylinder, and that is [25] an issue here, but I believe that the Court should certainly question whether the plaintiff has in his claim set forth a solution to that problem. I think the Court should also consider whether the plaintiff has disclosed this solution to the problem.

The Court: Is that it? Are we ready to take evidence now?

Mr. Nakamura: Yes, Your Honor.

Mr. Calimafde: Your Honor, the issue has been defined further than I contemplated.

Is Mr. Nakamura conceding that if the claim does include these limitations that the claim is patentable? Are we now down to the issue as to whether the claim is deficient for not reciting the structure?

Mr. Nakamura: It is up to you to prove that it is there.

Mr. Calimafde: If I prove it is there, will you concede that it is patentable?

Mr. Nakamura: No, I won't concede that.

The Court: Well, now, I didn't quite get the end of that. I didn't get the middle of it, actually. What are you going to prove is there?

Mr. Calimafde: I am going to prove that the [26] expanding gas is in the claim recited as a means.

The Court: As a consequence of the question I asked him. All right.

Mr. Nakamura: May I add one thing to that.

Counsel referred to Venturi. I believe that is what he will have to show.

Mr. Calimafde: I referred to a Venturi as the means for producing the expanding gas.

The Court: Some sort of an hour glass device where the gas is forced into a narrow constricted area. When it gets out it expands. Isn't that it?

Mr. Calimafde: Correct, Your Honor.

The Court: As a consequence of the expansion, as I understand it in layman's terms, it approaches the outer surface of the inner cylinder wall and the water which has a tendency to fly off, stays on. Isn't that the story?

Mr. Calimafde: That is the story.

The Court: You don't agree with that?

Mr. Nakamura: That is my understanding.

The Court: Do you agree with it? In other words, if he proves that, he has an invention from the standpoint of Claim 20?

Mr. Nakamura: No.

The Court: You took a long time to say no. All right.

[27] Mr. Calimafde: I call Major DeSeversky as the first witness to the stand, and perhaps while the Major is getting to the stand I can dispose of the Penny patent. I didn't mention Penny in my opening remarks because Penny was cited by the Patent Office for one reason.

The Court: I said it is in the nature of a corollary. I asked the question.

Mr. Calimafde: Penny discloses a recirculating technique, and we don't claim any invention in the—

The Court: Let me make this suggestion—

(Remarks off the record.)

Thereupon

Alexander P. DeSeversky

was called as a witness by counsel for the plaintiff, and having been duly sworn was examined and testified as follows:

Direct Examination

By Mr. Calimafde:

Q. Will you please state your name? And your age and address? A. My name is Alexander P. DeSeversky, and my age is 73.

The Court: May I interpolate just as a matter of curiosity, are you the Alexander DeSeversky—

The Witness: Yes, sir.

[28] The Court: It is a pleasure meeting you. You are the Alexander DeSeversky. All right.

The inventor of the helicopter?

The Witness: No sir. I am the inventor of the Thurnderbolt fighter. Also the bombsight for General Mitchell, and I have made a number of the inventions in aeronautics. Mr. Sokorsky (sic) and myself—

The Court: That is it.

The Witness: We are alway mixed up—

The Court: You are both good men.

The Witness: So I get all the credit for his, and he gets credit for mine.

The Court: You both made a great contribution to the world.

The Witness: Thank you, sir.

By Mr. Calimafde:

Q. What is your present occupation, sir? A. I am President of the Electronatom Corporation and I am consultant to the Air Force, to the Chief of Staff of the Air Force, and I, also, during the last war was special consultant and advisor to the Secretary of War.

Q. Will you give us a brief resume of your professional background as it might apply to the invention in controversy here? [29] A. It is very difficult for me to do this. I have made quite a few basic inventions—

The Court: Are you an engineer of a chemist?

The Witness: No, I am an electrical, mechanical and aeronautical engineer, and I have a license to practice this—

Mr. Calimafde: Your Honor will take judicial notice that the man has expertise in the area of aerodynamics field.

By Mr. Calimafde:

Q. When did you first enter the field of electrostatic precipitators? A. When Russia exploded its hydrogen

bomb and our country was under threat of nuclear attack, and we felt our people ought to be protected, the first question of the air shelters came along, and also underground installations for our military headquarters and our missiles, being consultant with the Air Force we were faced with a problem of taking radioactive particles from the breathing air. At that time the Atomic Energy Commission developed an ordinary fiber glass filter with very small pores. The problem with the filter was when it begins to accumulate particles it becomes so hot it will kill everybody in the shelter. They asked me if I can work with that [30] and see if I can solve this particular problem.

Q. What year are we talking about? A. We are talking about, well, 1950 and '51.

Now, I was present at the atomic tests, so I was very familiar with radioactivity and also the character of the fallout, and I knew that with the best protection is several foot of earth between the radioactive particles and human being. Therefore, I came to a conclusion the only way it can be done by draining the radioactive particles deep underground, so that to protect the people in the shelter, and I came to electrostatic precipitator, so-called wet type precipitator where you collect impurities in the film of water and that water is being drained underground.

Now, the principle of electrostatic precipitator was first discovered in 1772, so like electricity has been discovered many years ago, but it is different how you utilize this energy. You can build electric motor, you can apply to telephone, telegraph, or computer. Even though they are all basic in principle of electric current, they all are distinct and different inventions. Therefore, it is the manner in which you apply the electrostatic forces, and apply the high voltage, and apply all the components like water that has to clean the air—that is what makes the device operative, practical and [31] accomplish what we set out to accomplish.

So, the first natural idea was to have a tube and put the electrode in the center, which was very impractical—

Q. Did you look for that kind of precipitator when you sought out to solve— A. No. At that time I was totally oblivious of the art, and my first—when I came to the conclusion it should be liquid precipitator I wrote to several precipitation companies and asked them would they construct one that is like this, and I got very discouraging response. They did not recommend to go into the wet precipitator because, first, you cannot move gasses very fast.

The Court: You can't move what?

The Witness: Gasses, or air. Because if you move it too fast it blows the water right out of the tube, which, indeed, happened when we built even ordinary tube, as Burns does. It works only very short distance and also works only when you move gasses very slow. Now, if you want to pass a lot of gass clean through small unit, you have to move gasses very fast, and if you move gasses very fast, then the water is blown right out of the tube. Even in Burns case where it is supported by centrifugal force. So there was a problem how to remove the gasses fast—

[32] By Mr. Calimafde:

Q. Now, Major, when you say "move gasses fast," you mean move the gas through the cylinder? A. Through the cylinder.

Q. From the bottom to the top? A. Yes.

And we came upon a discovery if we introduced Venturi at the bottom of certain shape, certain configuration, the expansion of gasses support the film and the water does not blow out of the unit. And it has been demonstrated many times by removing the Venturi the water at high velocity is blown right out of the unit and the unit is inoperative. By putting the Venturi where it belongs you can move the gas very fast. There are electrostatic precipitators based

upon Burns patent. On the average they move gasses only three hundred feet a minute. We, in our unit, which is now in production, is moving at 1600 feet a minute. Experimentally, we are able to move gas three thousand feet a minute, ten times as fast, and yet with not a droplet of water separates, short circuit the unit—the unit operates beautifully at all times.

The Court: May I interrupt a moment in order to have myself informed?

The term used "electrostatic precipitator"— [33] now, precipitator is that something that relates to water; is that it?

Mr. Calimafde: Well, the word "precipitator"—

The Court: It is the whole device. I know that.

Mr. Calimafde: Yes.

The Court: I am talking about the use of the term particularly here.

Mr. Calimafde: It means to separate out of something. You precipitate these contaminant particles out of the gas.

The Court: Now, "electrostatic"—I am not an engineer of any kind, and the only familiarity I have with the term "electrostatic" in its generic sense, and not in its artistic sense, is that that there is such a thing as static electricity. For example, I can walk on a carpeted floor and step on a bare spot—as long as I don't step on a bare spot I can put a playing card on the wall, pastered wall. You run into static electricity in the home occasionally. You see what I mean?

Now, what is the use of the term here, "electrostatic precipitator"?

I am asking you (indicating) but I am looking at you.

[34] The Witness: Well, if you rub, for example, a stick and a little piece of paper on the floor, on the table, it attracts—the piece of paper will fly to the stick. So imagine the same situation in the electrostatic precipitator. The gasses filled with minute particles which contaminate the air. They are in the form of solids, in the form of mist.

If you create electrostatic field like you create with this little rod, all the particles begin to stream in one direction from the discharge electrode to the collector electrode—

The Court: That is good. I don't want to manifest such a dismal lack of knowledge, but it is not my field by a long shot.

Very good. Thank you.

Mr. Calimafde: I walked the same ground not too long ago, Your Honor.

The Court: You are walking it very well up to now.

By Mr. Calimafde:

Q. Major you heard my explanation of Claim 20. A. Yes.

Q. To save time, do you adopt that explanation as a fair explanation of the invention defined in Claim 20? A. Yes. I would like to demonstrate—

Q. Well, let's get to the demonstration, I think later. [35] Do you have a film with you which illustrates your precipitator? A. Yes, I do.

Q. Was this film taken under your supervision? A. I do it myself. It is amateur film, about twelve minutes.

Q. And the film illustrates the type of electrostatic precipitator involved in this controversy? A. In this action, yes.

Q. Does the precipitator photographed consist of two cylinders of the wet surface type that we are discussing here? A. Yes. I would like to—you have it in your hand. That is exactly the precipitator that is going to be demonstrated.

The Court: Let the record indicate that counsel is showing a brochure entitled what?

Mr. Calimafde: Hydro-Precipitrol.

The Court: And that is Exhibit Number 4.

(Plaintiff's Exhibit Number 4 was marked for identification.)

The Witness: It has an outer tube and an inner tube. This is the same thing. First we wash the gasses—first we

scrub the gas in the scrubber to take the large [36] particles.

Mr. Calimafde: The witness is pointing to the—

The Court: The base of the tubular apparatus.

Where is it?

The Witness: Here. This is the inner wall, and outer wall.

The Court: Where is the gas?

The Witness: The gas goes through here and enters in here. (Indicating) Exactly as on that model.

The Court: Where is this so-called washout you refer to?

The Witness: This is just the—

The Court: Where it is marked "Gas Inlet."

The Witness: Yes. Gas comes in here, and the first wash takes the crude large particles, like vapors or anything that may go in there, and then the fine particles that you cannot wash out can be taken out of the air only through electrostatic percipitation unless you go into very expensive and large so-called high energy scrubbers. So gas now enters into this doughnut annular space—

The Court: Right here. (Indicating)

The Witness: And this is the discharge electrode in here. It is also annular all the way around in the center, [37] and that is where the small particles which are harmful to public health, cause cancer and emphysema, we are able to take through these means, these particles from discharge electrode through the film of water and on the outer and inner cylinder, and this is being drained away.

The Court: Goes down in the so-called sump pump.

The Witness: Goes out in the tank and out in the septic tank.

The Court: All right. Thank you.

You are proffering this?

Mr. Calimafde: May we offer it?

(Plaintiff's Exhibit Number 4 was received in evidence.)

The Court: It is the sales brochure which merely outlines—let me put it on the record so you will understand

it—it says—it is denominated Plaintiff's Exhibit Number 4 calling attention of the Court to what might be characterized as Page 2 of the brochure which relates to the apparatus itself by way of diagramatic representation.

Mr. Nakamura: All right.

Mr. Calimafde: The record should show the witness is going to show the film which he partly took and narrated.

(Therefore, the film was shown to the Court.)

[38] The Witness: This is in the city of Chicago. This is on the houses where the unit is going to be tested by air pollution control and also by the federal authority, and also will be used as an instrument of research in the air pollution field caused by incinerators, because until this device was produced there was no sophisticated device available to do this research, and now because we developed this use which is operable, the federal government will use it for investigation of the whole phenomena. And, of course, the federal government provided grants for that, they wanted to do further research.

Now, this is an apartment house for elder citizens where they propose to use the roof for recreation so they can play tennis and other games, and maybe a swimming pool, and so on. It was very imperative for them to have a device to extract all the particles, even small particles which are harmful to health. Nothing was available. They advertised throughout the industry. There was no response. Our device was the only one which could achieve this performance and was chosen by the housing authority for the first installation for the elderly citizens. And once it will go through routine check I am sure will be released because of benefit to health, particularly for elder citizens who are confined to restricted area. And this shows an actual installation of the unit on the roof of the [39] building, and they will also show instrumentation, instruments to show it cleans the air by using this. It has been in operation for five or six months and so far it does not re-

quire any attention by the janitor. It operates because it is self-cleaning device which has been described before.

This is a view from the top down on the device as it is installed on the roof of the elder citizens' home.

And now, again, we put in operation and it shows how it works. The stack is absolutely clean and no harmful material coming out to endanger the health of the people who use the roof for recreation.

This ends the film.

The Court: Thank you very much. We will suspend now. Put the lights on, please.

We will come back at half past one.

(Thereupon, at 12:15 p.m., the above proceedings were adjourned until 1:30 p.m.)

[40] Afternoon Session (1:35 p.m.)

(Witness resumed the stand. Direct examination continued:)

By Mr. Calimafde:

Q. Major, are you familiar with the Nesbit patent? A. Yes.

Q. Have you ever tried making the dry dual cylinder type of precipitator? A. Yes, we did, but I was—I was against dry precipitator because there is—it is very complicated and expensive way of cleaning. And in addition to that, in many instances the particles extracted are either tar, or oil and grease, and it is very difficult to clean them, and as the dry precipitator precipitates, its performance or efficiency constantly drops down as the electrode begins to be smeared with the residue extracted from the gas. So I felt that the Burns idea of having a liquid is more practical because then your efficiency, all the time operates at top efficiency because your electrodes are always clean.

Q. How does one clean the Nesbit type of precipitator? A. Well, they shake it, they rap it and, of course, if it is stuff that adheres to—that drops down, you have a [41]

problem because when it drops down it is being charged again and precipitates again against the wall and, of course, there are mechanical cleaners, scrubbing of the plates, but in that case the precipitator has to be stopped in order to accomplish the cleaning. Exactly what his patent says—he has to stop, wash and clean it between operations, whereas the wet electrostatic precipitator itself cleans and does not require any maintenance and, therefore, is very inexpensive to operate.

Q. Are you familiar with the Burns patent? A. Yes.

Q. You tried to make a tubular type wet precipitator of the kind disclosed in the Burns patent? A. Yes. Again, I found that it works only over very short distance while the water spins there. In addition to that, in order to clean great volume of gas the only alternative you have is to multiply number of cylinders, or to increase their diameter. But increase of diameter is limited. If you increase your diameter you have to use higher and higher electric potential. Would be one hundred thousand, two hundred thousand volts, and because impossible to maintain this potential because there is a considerable leakage and most of your energy is lost. Therefore, it becomes impractical commercially.

[42] So then I came to the idea to have an annular or two cylinders, a center cylinder—

Q. Before you get to a description of your type of precipitator, Major, does Burns explain how he applies the water to the inside surface of his tube? A. Yes, he does. He says he applies it tangentially, allow the water to spin, and because he find out it is absolutely essential to produce very smooth surface, because if any protrusions or any departure of small droplets of water it will make the electrostatic precipitator inoperative.

The Court: May I have the witness shown Exhibit Number 2? I am concerned with the use of the term "tangentially." That means one thing to me in mathematics. I assume you are using it in a generic English sense; is that

right? In other words, it goes off in relation to the circumference of the tube, is that it? Oh what?

The Witness: Your Honor, I have a model—

The Court: Very well. Let me see the model. I don't want to take over direction of the case nor permit the witness to do so, either.

The Witness: Excuse me, please. I didn't realize—

The Court: All right.

[43] By Mr. Calimafde:

Q. Let him answer the question which is outstanding. A tangential application means that the water is applied to the surface, the inside surface of the tube so that at any curved surface the water is aimed just at the surface—

The Court: I see.

By Mr. Calimafde:

Q. Will you demonstrate with the cylindrical model you have? A. This is a very simple model.

The Court: Now, this is the model of Burns—

The Witness: This is both. If I take out the inner cylinder it becomes Burns' system. So I will start with the Burns' system.

Now, I assume that this little ping-pong ball is a molecule of water, droplet of water. Tangentially you release it at the right angle of this thing. When you do this inside of the cylinder, it stays. Now, I am sure Burns tried to do this, and do this on the outside. If I do this outside I am afraid it is going to hit Mr. Nakamura.

(Remarks off the record.)

Mr. Calimafde: The record should show that the [44] witness has a transparent plastic cylinder with an inside diameter of about five inches, and to demonstrate the travel of the water down the inside of the—inside surface of the cylinder, he projected a ping-pong ball, and the ping-pong ball traveled down the inside surface of the cylinder re-

maining close to the surface of the cylinder; is that correct?

The Witness: Yes, sir.

The Court: Now, may I anticipate, to make sure I understand. Now you are going to take the so-called inner cylinder and insert it in the larger cylinder.

The Witness: I cannot do this because the ball is too large. So I assume now that this is the inner cylinder of our larger cylinder. Now, obviously, I cannot use tangential injection of water which Mr. Burns says very essential to provide the smooth film. So something else has to be done in order to sustain the film injected tangentially and spinning around, yet the drops of the water will not fly off and will not shorten and make the electrostatic precipitator inoperative. It took us a long time, ten years and a great deal of work finally to find out how we can do this. And we do this by injecting the gasses through this tube and let the gasses expand, and this expansion of the gasses provide the pressure on the water.

The Court: Keeping the water on the surface of [45] the inner tube, inner cylinder; is that it?

The Witness: That is right, sir. Just like this. So you actually have—

The Court: In other words, your hand is acting as the gas.

The Witness: As the gas. Now it can rotate because centrifugal force, you see, is equalized by the gas pressure—

The Court: In other words, the tendency to fly off is obviated by the pressure of the gas as represented by your hand.

The Witness: Yes, Your Honor.

The Court: I see.

The Witness: So, from then, of course—that is what solved the problem. There are other things, as I explained before—for practical use, if you have just a single cylinder this gap you cannot expand indefinitely because you will have to have a tremendous potential which really will produce spark and very dangerous operation. So the only

solution for practical application will be the use of these cylinders. All labor, engineering and work connected on top where it is suspended, when you distribute your water, and on the bottom to take this water out and take all of the impurities out. The cylinder itself does not represent considerable value.

[46] The Court: These cyclinders are made of what in the actual device?

The Witness: In our actual device it is ceramic, because water really is a conductor. So the reason—so, therefore, every time you reproduce another cylinder you have to go through all the difficulties of distributing water, provide for the electrodes, and so on.

By Mr. Calimafde:

Q. Now you are talking about the Burns type. A. The Burns type.

Q. And Burns type construction utilizes simply a tube or cylinder. A. That is right.

Q. And the water travels down inside the surface of the cylinder. A. That is right.

Q. And Burns has an electrode which is located along the axis of the cylinder? A. That is right. If he has to clean the great volume of air the only way he can do it by multiplying this unit.

The Court: He applies water in a circular direction, is that it? Burns?

Mr. Calimafde: Burns applies water in a circular [47] direction to the inside of the tube, and the ping-pong ball demonstration was to show Your Honor that when you apply a water droplet with a centrifugal force, the droplet tends to remain against the wall, tends not to splash off in the Burns situation.

The Witness: What I am trying to show, Your Honor is that this Burns device is limited commercially because it is very uneconomical to produce a great many cylinders. Each cylinder contains its own distributor, its own sup-

port of high voltage, and becomes so expensive that it is utterly impractical and, therefore, it does not provide the means of technology so that air pollution control can be enforced because it is not economical. So we tried to work out a system that is very simple, cheap, so that the control of air pollution can become a reality because it is based on the technology available and economically practical.

So, in our case when we have annular system—

Mr. Calimafde: Let the record show that the witness has placed the outer tubular member concentrically around a smaller cylindrical member.

By Mr. Calimafde:

Q. Now, what is this intended to represent? A. This represents our patent.

[48] Q. Patent application. A. Patent application.

I can expand this any diameter you want because the gap remains the same. Therefore, with the same potential you can build one unit which will process a large amount of gas.

The Court: In other words, the size of the unit is dependent upon the obstacle to be overcome, from the standpoint of debris or pollution.

The Witness: That is right.

So this really is what made an economic breakthrough and made it possible now to control all sorts of small—like apartment houses—small industries which before could not be controlled because the electrostatic precipitators were extremely expensive, required expert attention, and they couldn't be worked simply unattended. So this really solved the problem, and the solution came when we were able to maintain the water film on the inner cylinder, because it isn't so simple. I don't think it is obvious. If you see those two devices, it is not obvious, because it took us many years and many dollars, really, in research to finally be able to make the system work.

The Court: Now, this is the device stripped down to its barest essentials and predicated on the theory that you have evolved and characterized as practical.

The Witness: Yes.

[49] Mr. Calimafde: For your information, Your Honor, the electrode would be located in this space between the two cylinders at several points.

The Court: Yes, I understand that. I am only concerned with, actually, what happens from the standpoint of the implementation of the theory he presently demonstrated.

You may sit down, Major, if you want to.

By Mr. Calimafde:

Q. When you consider it, first, the concentric cylinders, did you try applying water to the outer surface of the inner cylinder and the inside surface of the outer cylinder in your initial experimentation, and what success and failure did you have? A. This only worked when the gas was moving extremely slow, you see.

Q. Now, you are talking about applying the water? A. Yes.

Q. To the opposing surfaces. A. Yes.

Q. How was the water—

The Court: Not in the Burns' fashion.

Mr. Calimafde: Well, let's find that out.

Initially, when you applied water to the opposing [50] surfaces—

The Witness: Yes.

By Mr. Calimafde:

Q. Did you apply it with a circular direction? A. Yes. A circular direction, and the water was naturally shooting off the inner electrode and made the device inoperable.

The Court: By the operation of centrifugal force.

The Witness: Yes. If you don't do this and you operate the device when the air moves so slow it becomes impractical, and another thing, it makes it impractical, it won't move as much volume of gas—the faster you can

move your gasses—the more gasses, in smaller space, the more efficient becomes the device, and that cannot be done by using a Burns system. You have to do something else in order to support—

The Court: Burns doesn't use gas at all—Burns doesn't.

Mr. Calimafde: He passes gas through the tube.

The Court: Through the tube?

The Witness: He doesn't use gas to support the water film.

The Court: That's right. He doesn't use gas for the use of the Venturi, either, does he?

The Witness: No, sir.

[51] By Mr. Calimafde:

Q. Major, in your experimentation did you attempt to apply water so it simply traveled vertically downwardly rather than water in a circular direction? A. Well, if you do this, then you don't wet your electrode properly.

Q. Did you try that? A. We tried, and it didn't work. You have to rotate the water in order to get the smooth film.

Q. Now, what does "peel-off" mean in the art? A. Well, "Peel-off" means droplets of water separate from the water towards the discharged electrode and they shorten the high voltage, and when it shortens your device becomes inoperative.

Q. What causes peel-off? A. Centrifugal force of the water, and, also, electrostatic film on the water, too.

Q. You showed a film earlier which purported to be a demonstration of your precipitator. Did you get reactions from responsible people in government concerning your demonstrations? A. Yes, I did. In New York and also in Chicago when the device was witnessed by the Commissioner of Air Pollution, a [52] great expert in his field in his own right. Has even more experience than I have in this field because he started earlier, and he wrote me a letter which expressed his reaction to what I have done.

Q. I am sorry, Major, I missed something. Did you say a reaction from someone in Chicago, or New York? A. Chicago and New York.

The Court: He is talking about the New York gentleman now, though? You are referring to the New York gentleman by way of a letter, isn't that right?

The Witness: Yes, sir.

By Mr. Calimafde:

Q. Do you know the name of the Commissioner? A. Commissioner Brown in New York, and Commissioner Fitzpatrick in Chicago.

The Court: Commissioner Brown—Commissioner of what?

The Witness: City Commissioner of Purchasing. And the Commissioner in Chicago, Commissioner Fitzpatrick, Commissioner of Air Pollution.

By Mr. Calimafde:

Q. Of Chicago? A. Yes.

[53] Q. I will show you a letter dated October 31, 1962 addressed to Dear "Sasha" (sic). I guess that is you. A. That is my nickname.

Q. From Roger J. Brown, Commissioner, and ask whether you can identify it? A. That is right.

Q. Is that the letter from Mr. Brown to you? A. Yes.

Q. Commenting on the demonstration? A. That is right.

Q. I offer that as—

The Court: Exhibit 5.

Mr. Calimafde: Exhibit 5.

Have you seen this, Mr. Nakamura?

(Shown to defense counsel.)

(Plaintiff's Exhibit No. 5 was received in evidence.)

The Court: What is the date of this application for patent?

Mr. Calimafde: What is the date of what, Your Honor?

The Court: The application—

Mr. Calimafde: August 31, 1960.

[54] Mr. Calimafde: This is Number 6.

The Court: May I read those, please?

The Deputy Clerk: Will Your Honor admit Number 6 as well?

The Court: For identification up to now.

(Plaintiff's Exhibit Number 6 was marked for identification.)

Mr. Calimafde: Shall I have the witness authenticate—

The Court: I am assuming—you raise no question about the authenticity of these documents, do you?

Mr. Nakamura: No, I do not, Your Honor.

The Court: I didn't think so.

(Handed to the Court.)

The Court: Are you proferring these exhibits now in evidence?

Mr. Calimafde: Yes, Your Honor.

The Court: No objection?

Mr. Nakamura: No objection.

The Court: They are in evidence.

(Plaintiff's Exhibit Number 6 was received in evidence.)

Mr. Calimafde: No further questions.

[55] Cross-Examination

By Mr. Nakamura:

Q. Major, in your direct testimony you stated that the expansion of gas in your apparatus is responsible for maintaining the water film on the inner cylinder; is that correct? A. That is correct.

Q. Can you point out in your application specifications where that is described? A. Yes.

The Court: Well, now, let's present the witness with the application. I think that is the best thing to do.

I think we are talking now about the application as an instrument rather than an exhibit.

Mr. Calimafde: Your Honor, perhaps I can save time on this by directing the witness to the specific place in the application.

The Court: That is all right. Make sure it is in the application. That is what counsel wants to know. You want to know whether it is in the application or not?

Mr. Nakamura: That is right.

(Shown to defense counsel.)

(Handed to the witness.)

The Court: For the record, you are showing the [56] witness what?

Mr. Nakamura: I am showing the witness Page 48 of the certified copy of the File Wrapper History, in evidence.

The Court: In evidence.

Mr. Nakamura: In evidence. That is Exhibit 1.

The Court: Now, Major, what do you read on Page 48? What does that purport to be, Page 48?

The Witness: 48. This application is a continuation of my application Serial Number 855,369.

The Court: Very well, counsel.

The Witness: It is a patent application, so when I refer to the means to sustain the water, film of water, I refer to the means fully completely described of the previous patent which I made a part of this particular patent.

The Court: I understood the question, now, is whether or not the expansion of gas was responsible for the maintenance of water on the surface? Is that it? Was that the gist of your question?

Mr. Nakamura: Yes, Your Honor.

The Court: Where that is in the application. Do you find it there?

The Witness: Yes, sir. Let me read this particular claim—

[57] The Court: Let me see it, and that will be all right.

We will save a little time.

The Witness: I refer to the means.

The Court: I understand.

The Witness: And when I say "means" of sustaining the film of water I make a reference to my previous patent. It is part of this application where I fully describe the Venturi that supports the film.

The Court: Referring to Page 2 of this copy, and it says "B." Capital "B." "Means to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage."

And now you are saying that the previous application in relation to the means includes gas?

The Witness: Yes, venturi and gas, yes, sir.

The Court: That is what he said. The previous application—have you seen that?

By Mr. Nakamura:

Q. Do I understand, Major, that the previous application you are referring to here is the one that is now issued as a patent? [58] A. No—yes—in this patent I refer to the previous application. I say my previous application filed in November '59—in this application I describe the means of producing the water film through expansion of gasses. So in this patent I refer to the means to support the film, to create the uniform means on the outer inner cylinder. Those means are fully explained in my previous patent which is made the part of the present application that is in question now.

The Court: That is the previous patent you have there. Let's have it marked for identification. Have the witness identify it.

Mr. Calimafde: Number 7. Patent Number 2,937,709, which is parent to the application now in controversy. Exhibit 7.

(Plaintiff's Exhibit Number 7 was marked for identification.)

The Witness: In this case the bottom of the tubes 1, are flared outward as shown to prevent restriction of air flow

and thereby take full advantage of their capacity. Moreover, the construction of such—is such that the liquid of the film flows outside the tubes 34 to fall into reservoir 11. The venturi effect produced by constricted upper ends of the tube 34 is to be noted. The consequent air expansion as air [59] leaves the tubes tend to help keep water against the inner wall of the tube."

The Court: Now, you are reading from Line 26 to Line 35 inclusive.

The Witness: Yes, sir.

The Court: On Page 6 of the application. The application is 2,937,709, and was filed January 5, 1955.

Did you get that, Miss Reporter?

"In this case the bottom of the tubes 1 are flared outward as shown to prevent restriction of air flow and thereby take full advantage of their capacity. Moreover, the construction is such that the liquid of the film flows outside the tubes 34 to fall into reservoir 11. The venturi effect produced by constricted upper ends of tubes 34 is to be noted. The consequent air expansion as air leaves the tubes tends to keep water against the inner walls 9 of tube 1."

In other words, air is to be equated with gas?

The Witness: Yes, sir.

By Mr. Nakamura:

Q. Major, would you please turn to Page 2 of the drawings of Patent Number 2,937,709, which is Plaintiff's Exhibit [60] Number 7? The one you just looked at. A. Page—which?

Q. Page 2 of the drawings. A. Yes, sir.

Q. This is the Figure 6 at the bottom of the page. A. Yes.

Q. To which you referred, in the written description. A. Yes. This shows the venturi expansion of the gas.

Q. Would you identify the part that you consider the venturi as the number that has the gradual curvature in-

ward and is numbered 34? Is that the part that produces the venturi effect? A. Yes. I mean, which one? The other patent?

Yes, sir.

The Court: What figure is that?

The Witness: That is Figure 6, Your Honor.

The Court: I see. Figure 6 in 2,937,709.

Thank you.

By Mr. Nakamura:

Q. Major, do you have the copy of the Burns patent before you?

The Court: I'm sorry, I didn't get you.

Mr. Nakamura: The Burns patent.

[61] The Court: The Burns patent.

Mr. Nakamura: Defendant's Exhibit 1-A.

The Court: Now you are calling his atention to what page, what line, if any, or are you going to inquire generally?

By Mr. Nakamura:

Q. I would like the Major to consider Page 1 of the drawing.

The Court: Page 1 of the drawing.

The Witness: Yes, I have it.

By Mr. Nakamura:

Q. Figure 4 at the bottom of the page. A. Yes.

The Court: Wait a minute until I get that.

I have it. Thank you.

By Mr. Nakamura:

Q. Major, do you see in this figure an element labeled 17 which reduces in diameter? Is that shown in Figure 4? A. Yes, but you will notice the lips of that are parallel to the wall. No venturi effect at all. You have a straight column of air.

Q. Does the air go into that curved Number 17, pass through it? [62] A. Yes.

Q. Goes out of the top of it? A. That is true, but he uses it simply to leave passage for the water to go by—he doesn't use it to produce venturi effect in expansion, and he doesn't mention it. It is obvious from his drawings that he simply leaves a little gap, he makes an inner tube a little bit smaller in diameter so the water can go by that. It has nothing to do with the action of a venturi whereas in my invention Patent 2,937,709, you can see how the inner part of the venturi—you have a venturi effect. It is entirely different.

Q. Major, in Figure 6 of your patent No. 2,937,709, which is Plaintiff's Exhibit Number 7, the air progresses upwardly in Number 34 from a greater cross-section to a lesser cross-section; is that correct? A. Would you repeat the last—

The Court: Where are you reading from again?

Mr. Nakamura: This was a question, Your Honor. Would the reporter please read my question back?

(Question read by the reporter.)

The Witness: That is correct.

By Mr. Nakamura:

Q. Major, in the Burns patent, which is Defendant's [67] Exhibit 1-A, Figure 4, does the air pass upwardly in the Number 17 to a greater cross-section to a lesser cross-section? A. That is not enough to cause a venturi action.

Q. Does the air, after it leaves the top of Number 17 in Burns, pass into an area of greater—to a volume of greater cross-sectional area? A. No. That is not venturi. What causes the venturi, as you can see, the air, when it leaves the venturi, it directionally is toward the center. It compresses the air. Whereas, in Burns, it leaves a vertical column of air.

Q. Major, I am thinking of the air when it first enters the bottom of the Number 17 in Figure 4 of Burns. At that

time there is a large—at that place there is a large diameter as the air progresses upwardly the air decreases, does it not? A. Mr. Nakamura, the air envelopes our entire planet. If you want to process part of the air you certainly will have to take part of the air and reduce it to some small sort of vessel you can handle. That doesn't mean that you get necessarily a venturi effect. You have to take from the large volume which envelopes our atmosphere and bring it to the smaller tube that you want to process, because you process only part of the world's atmosphere. You don't process the whole atmosphere. It is how [64] you make that air behave when it leaves the tube. If the air leaves the tube in the direction so it is compressed and expands, then you have a venturi effect. If you take part of the world air and put in a smaller vessel and let it simply enter your device without any—just parallel, without any intention of making that air behave as you want it to behave, that is the difference between the two patents. But the fact that he takes from a larger vessel and comes to a smaller vessel, it is inevitable, because you have to process only part of the world's atmosphere.

Q. Major, let me ask you this one question on Burns patent again: does the air in passing through the Number 17 in Figure 4 become compressed and then expand as it leaves Number 17 at the bottom? A. Well, it may be at the very lips, he may have some expansion, but the purpose of this thing is not to produce venturi action, but simply he had to do it in order to let the water go by. There is no venturi, no venturi action whatsoever. If there is, it is accidental, and it is not the purpose of his invention. The gap is simply made to let the water go by so the water could be drained from the tube. Whereas, in my invention as the patent label granted it distinctly shows the compressed air so that air will expand to support the film.

[65] Q. Major, in Figure 6 of your patent 2,937,709, am I to understand correctly that the air, as it passes upwardly through Number 34 will become first compressed, and as it

leaves the top of Number 34 it expands? A. No. If you will notice very carefully on this patent, in the curve, it goes inside, you notice it? So when the air goes in here, the air, from the momentum will come from the very narrow column and will expand. Whereas, in Burns patent it comes out straight.

Q. Major, let me ask you this about Figure 6 in Patent Number 2,937,709, your patent— A. Yes.

Q. Does it show the inner tube, the inner concentric tube of your apparatus? A. No. This particular, it doesn't show. But I refer to, in my patent, when I say the means to support I referred particularly to Figure 6 because if you look at the other invention you find out that venturi now, instead of circular, becomes the annular all around for all the air is emitting through the venturi because the thrust is the same—my venturi is always designed that I have venturi action all the way around the annular chamber of the precipitator.

[66] Q. Major, is that described in the specification of your application, Plaintiff's Exhibit 3? A. Yes, sir. Described by referring to the means for accomplishing the support of the water film, and this means refers to means described in Patent 2,937,709, which is part of my application that now is before this Court.

Q. Then, major, do I understand that the disclosure which supports the expansion of the air is this passage that you read from your previous patent, Number 2,937,709; is that correct? A. That is correct.

Q. Major, do you have a copy of the claim in suit before you in Plaintiff's Exhibit Number 3?

The Court: Now you are showing the witness what is Exhibit Number 2, is it, marked for identification—in evidence? Is that Number 2?

Mr. Nakamura: Number 1.

The Court: Number 1. All right.

The answer is yes, that you have it before you.

The Witness: Yes, I do. I have it.

By Mr. Nakamura:

Q. Major, are you referring to the chart, Plaintiff's Exhibit Number 1 now? A. Yes.

[67] Q. Can you point out in there where you have claimed the venturi? A. Well, there is a little venturi—

The Court: Let's get this on the record. The witness is now pointing to what, on the exhibit?

The Witness: "C" is the shape of the venturi.

The Court: I mean the function is—

The Witness: Yes. This is diagramatic, a diagramatic drawing, but it shows a venturi entrance.

The Court: So your answer to that question is yes. There is on this drawing an indication of what is characterized as venturi.

The Witness: Yes, sir.

By Mr. Nakamura:

Q. Major, will you please turn to Page 79 of the exhibit, Plaintiff's Exhibit Number 3, which is the certified copy of your application. A. Page 79. Yes, I have it.

Q. Do you find Claim 20 on that page? A. Yes, I do.

Q. Will you point out wherein you find the word "venturi"? A. "Inlet means to introduce said contaminated gas [68] into the lower end of said annular passage between said troughs."

When I refer to "means," I refer to the means of making—to produce the film of water and as fully described in my previous patent that has been granted and which is made a part of this present application.

Q. Major, would you say that the venturi is the critical or essential element of your apparatus? A. Yes, I would say yes it is critical, and that is why I made the previous patent part of this patent, to make sure that the—I don't claim the same thing again that has already been claimed there, so I have shown that this is part of my system.

The Court: Well, you use the generic term "means" rather than the specific term "venturi," is what you are saying.

The Witness: Yes, sir.

The Court: And when you use the generic term "means," it means you refer antecedently to your reference to what you characterize as a venturi in your previous application—

The Witness: Yes, I made it a part of this application for that purpose.

May I add something?

[69] The Court: You may continue if you have a qualification.

The Witness: No qualification.

The Court: Well, if you have anything else to say in response to the question. I think you have answered it.

The Witness: I answered it, sir.

Mr. Nakamura: Your Honor, I have no further questions at the present.

The Court: I beg your pardon?

Mr. Nakamura: I have no further questions.

The Court: Any redirect?

Mr. Calimafde: No redirect.

The Court: You may step down. Thank you very much.

The exhibit Number 7 will be received in evidence. I assume you are going to proffer it.

You have no objection, Mr. Nakamura?

Mr. Nakamura: No objection.

The Court: That is the previous patent, for the record, No. 2,937,709, Gas Conditioner, A. P. DeSeversky, Filed January 5, 1955, granted May 24, 1960.

(Plaintiff's Exhibit No. 7 was received in evidence.)

[70] Mr. Calimafde: I call Doctor Spector to the stand, Your Honor.

Thereupon

Bertram Spector

was called as a witness by counsel for the plaintiff, and having been duly sworn was examined and testified as follows:

Direct Examination

By Mr. Calimafde:

Q. Would you please give your name and address? A. Bertram Spector, 1 Strafford Place, Seneca (sic) New York.

The Court: E-r or o-r?

The Witness: O-r.

By Mr. Calimafde:

Q. Give us a resume of your academic and professional background, please?

The Court: Well, we can go into his professional background. I am assuming he has the usual academic background. You have an undergraduate degree; is that right?

The Witness: Yes, sir.

The Court: And what is your field in professional work?

The Witness: Two fields, one is electrical [71] engineering, my first field. And, professionally, I headed the Bureau of Aeronautics Radar Anti-submarine Warfare Group for the United States Navy, Bureau of Aeronautics, as well as being consultant for numerous industrial organizations.

I then went back to graduate medical school to specialize in the health sciences and application of engineering through the health sciences including air pollution control. I graduated from Cornell Graduate Medical School, degree of PhD in this area.

The Court: Where did you get your degree?

The Witness: My electrical engineering?

The Court: Your BS.

The Witness: My Bachelor of Electrical Engineering, BEE Degree from the City College of the City University, New York.

Since then—do you want to hear any further qualifications?

The Court: I think your qualifications are extraordinary. We had better put more on the record.

The Witness: I would just like to state for the record that I have been a member of national committees, such as Air Pollution Control Association, committees for the setting of standards in air pollution control devices, and setting of [72] standards in air pollution for the nation. I have been consultant to the Commissioner of Air Pollution Control in New York, in Chicago, Seattle. I am Chairman and President of the IEEE, the Institute of Electronic Engineers, a special group interested in medicine and biology which has as one of its functions the applications to health engineering and air pollution—

The Court: Let me understand for the record. You are a PhD, Cornell Medical School.

The Witness: Graduate medical school.

The Court: Graduate medical school. You are not a professor in medicine—

The Witness: No. I went through medical school, but went on past medical school to go on through the health science areas and in graduate medical school.

The Court: And you are a graduate in electrical engineering—I see. Thank you.

By Mr. Calimafde:

Q. Is it your job to be informed of the air pollution equipment available today? A. Yes, it is.

Q. And are you familiar with air pollution equipment? A. Yes, I am.

[73] Q. Have you read the Burns patent? A. Yes, I have.

Q. And you understand it. A. Yes, I do.

Q. Will you direct your attention to Figure 4 of the Burns patent? A. Yes, I have it before me.

Q. Does Figure 4 disclose a venturi application? A. No, it does not, and I would like to add a point which I think the Major had made, but which I would like to express in a little different terms, technically. It is my professional opinion now that air which has been compressed and going through this Figure 4 and, in particular, Item—he has Item 17, 19 here, this constriction, because of the lack of the venturi at the exit end of it would cause a discontinuity and disruption and turbulence which would adversely affect any wet precipitator and, in fact, act to completely destroy the water film in that area.

It would be my opinion on this basis—

The Court: I beg your pardon. Go ahead.

The Witness: It would be my opinion on this basis that the Burns Figure 4 not only does not portray a venturi, but almost destroys the effectiveness of the total [74] apparatus, and it would be of great interest to me to determine whether this is even operable.

The Court: You raised the question in your answer that I was going to ask. What, specifically, is a venturi? I am asking you now as an expert in the field.

The Witness: A venturi is a device which will compress air according to a flow seam where in its exit end it will allow expansion in a continuous fashion. The curvatures of venturis are very very important in determining just how the gas expands and how it behaves. This was the point Major deSeversky referred to before—

The Court: That is good.

The Witness: Burns is half a venturi if one considers it. It leaves discontinuous the exit end, which is the most important end because that is the end that shapes the behavior of the gas, and, as such, at this point, at the point of this continuity where the air exits there would probably be what is known as "eddies" (sic), a turbulent stage, and this means small, just like in a whirlpool, small

little air currents, small little movements of air at random in different directions which would probably break up the water film and totally destroy the value—if there were high velocity gasses going through—of any contribution that would be made by a wet precipitator.

[75] In other words, the precipitator would become inoperative due to spark-off.

The Court: Do you regard "C" on Figure 1 of the present application as a true venturi?

The Witness: Yes, sir. This was original intent of the entire patent application with reference to the prior antecedent application. There is no question about that.

By Mr. Calimafde:

Q. Doctor Spector, looking at Figure 4 of the Burns patent, what is the purpose, according to Burns, for the Lip 17? A. Yes, sir.

May I quote Burns?

Q. Yes. A. I think there is no greater authority of what was in Burns' mind than Burns himself, and here—

Q. What column are you reading from?

The Court: What column, what page?

The Witness: This is Page —.

Mr. Calimafde: At the top.

The Court: Page 1?

The Witness: No. It is at the top, but—Page 2, Column 2, Line 73, and he says, quote—Burns:

[76] As shown in Figure 4, the spacing means for the discharge electrodes may be protected by false top or roof 17 extending over the same and formed with openings 18 for passage of the gas from the header tube to the collecting electrode members 1. These openings being surrounded by walls 19 for directing liquid to space above the roof number 17 whence the accumulated materials may be removed by drainage to the tank 14, or by flushing with liquid supplied through a pipe 23.

Now, therefore, it is shown it was merely a means of allowing the gas to go through, and the water to be discharged essentially—

The Court: May I ask this question: as I look at Figure 4 and then allude specifically to Number 17 in Figure 4, what has been referred to now in your testimony is not a venturi. Am I to do understand that that tube, or whatever you want to call it, that passage, or conduit, is perforated?

The Witness: No, sir, it is not perforated. This tube, the total intent of this tube is to separate the liquids that will be draining from the outer wall.

The Court: How does separation affect it? In [77] other words, you just read beginning on Line 73:

> "As shown in Figure 4, the spacing means for the discharge electrodes may be protected by false top or roof 17."

That is the false top or roof. (Indicating.)

The Witness: Yes.

The Court: "—extending over the same and formed with openings—"

The openings are 18. I see.

The Witness: Yes.

By Mr. Calimafde:

Q. Doctor Spector, isn't this opening which is shown between the wall 17 and the main tube what we have been calling a trough for collecting the water? A. Yes, which drains down the wall. And unless something is done by virtue of what I consider a shock, on the part of the Major, in ultimately arriving at a venturi, the turbulence caused by this—as a matter of fact, this actually, in my consulting activities, this actually has been one of the great impediments in wet electrostatic precipitators, even on inner walls of tubes, and certainly on the outer walls it would be ludicrous to assume it would be possible to have this type

of peculiar roof, as he calls it, to affect the behavior of the [78] gasses so as to sustain a uniform film.

Q. Well, apart from considerations of operability, does Figure 4 suggest to one skilled in the art, such as yourself, a venturi application of the gas? A. No, it does not.

Q. Are you familiar with the Nesbit patent? A. Yes, I am.

Q. Very briefly, what does the Nesbit patent disclose? A. The Nesbit patent, which is a dry precipitator patent, discloses essentially a concentric idea for electrostatic precipitator, that is, concentric cylinders which would be used in conservation of space, or in any application which would require a greater capacity than would be possible through the use of a single tube, and still do this with a reasonably high voltage potential—

Q. Nesbit discloses concentric cylinders, does he not? A. Yes, he does.

Q. In your travels as a result of your position with these various committees, have you seen a dry dual cylinder precipitator in operation? A. No, I have no.

Q. Do you know why the dry dual cylinder is not a [79] commercial type precipitator? A. Well, it has been stated before. Maybe it should be stated once again at this time. Dry precipitators, especially for certain types of application, and most certainly for applications we have seen here today, would not be effective because there would be steady accumulation and build-up of materials.

Might I quote directly from Burns, if you gentlemen are all familiar with Burns in some detail. Burns, himself, takes up this very point which would reject the idea of using the Nesbit type precipitator.

The Court: What page?

The Witness: On the first page of Burns patent on Line 44, he claims:

> "It is of great importance that the surface of the collecting electrodes should be smooth or free from

> sharp projections or roughness of any kind since such projections concentrate the electric field adjacent thereto and form centers of ionization and discharge with the result that the normal migration of suspended particles towards these electrodes is interfered with by the reverse charges involving the particles to the ionization of the gas adjacent [80] to the collecting electrodes. I have found that in many cases the material precipitated on the collecting electrodes tends to build up thereon so as to form projections—" and this is the basis here—"which act as centers of discharge and interfere in the manner stated with complete and effective migration of the particles and the gas passing through the apparatus with the result that a considerable portion of such particles fail to reach the collecting electrodes and are swept through the apparatus by the current of gas without precipitation."

And then it goes on to state that the important object here is to maintain this water film to prevent just this sort of thing.

I might state with due deference to Burns he understated the case considerably, because in addition to—

The Court: Let's forget Burns. If he understated his case, he got a patent, didn't he?

The Witness: Yes, he did get a patent.

The Court: So you have answered the question. Thank you.

Unless you want to say something with reference to this—

[81] The Witness: No, I think the point has been made, Your Honor.

By Mr. Calimafde:

Q. In the Burns patent is the water applied by jets so as to travel circularly down the wall of the tube? A. Well, the water has a tangential component, as we have gone

through, and I think it would be appropriate, again—this point has been made—but I think it would be appropriate, viewing it from a slightly technical point of view, as one might, to just consider forces that would take place in the Burns patent, and in the particular tube that he has used. Now, in this cylinder, first you have a tangential application with the resulting centrifugal force, and this was demonstrated in the Major's demonstration with the ping-pong ball in which it was clearly evident that the ping-pong ball or drop of water given this impetus and this tangential initial velocity, tangentially, that is, would tend to hug the wall and remain in contact and wet it uniformly.

Now, added to this, if we drew out a little force diagram, a diagram which would show the forces on a particle of water that is injected into this cylinder, we would find that we had the centrifugal force which is acting outward, or preventing the water from coming into the—toward the central [82] part of the tube, of the Burns tube. In other words, towards the discharge electrode which is just a central wire in the Burns patent.

Now, another force on this water would be the force that would tend to attract a drop of water which might have strayed from the main stream of water. In other words, a little protrusion, any disturbance which would allow a water droplet to disassociate itself or overcome the surface tension and be drawn toward the central electrode, would have—would be, in effect, drawn by a force electrostatically toward the center.

So now we have, so far, two forces we are talking about acting on this little water droplet which is near the inner surface of the outer electrode. One force, centrifugal force tending to force the water outwards, or away from the central electrode. The other, electrostatic force, which tends, as it would tend with any charged ion, to draw it towards the central electrode, which is opposite—

Q. Let me interrupt you to be sure I understand what you are saying.

You are now talking about the water which is traveling on the inside surface of the outer cylinder. A. That is true.

[83] Q. It is your testimony that that water has two components of force acting on it. A. No. It is my contention that it has at least more than two, but it has these two as well as others which I—

Q. You have described two so far. A. Yes.

Q. Centrifugal, tending to push the water into the wall. A. That's right.

Q. And the electric force tending to pull the water away from the wall toward the electrode. A. That is true.

Now, in addition to this, while all manufacturers, I guess, and people like to in general state that there is what is called laminar flow—that is a smooth and continuous flow, nothing discontinuous about it—if one would look at the velocity in cross-section, this would be continuous, and according to well known design in hydrodynamics, although one would like to say this is the case, this not usually the case. Usually there are what is called quasi-laminar or quasi-turbulent flow, even in the best designed equipment.

Now, in fully designed equipment such as Figure 4-A that we referred to before, patented or not, there is turbulent [84] flow at that point and there is no opportunity to—

The Court: Figure 4 of Burns, not 4-A.

The Witness: Figure 4. That is right.

Certainly, there would be, from discontinuity, turbulence in any flow at that point. In most precipitators, even those designed with very great care, this quasi-laminar, or, a little more extreme, quasi-turbulent flow, would affect droplets in the sense that the velocity of the air being a little different, or the gas going through, in different sections there would react at the boundary of its—react with the water slightly different, giving the water slightly different velocity, and then tending in some cases to allow this water to peel off, as has been mentioned. This term has been

mentioned before. So that there is another component. This is another smaller component, and this is the force that we might refer to as the small "eddies" (sic). So the centrifugal force that we were talking about before has to counter the attraction of the electrostatic attraction on the water particles. Two, it has to counter the smaller—in some cases smaller and in some cases larger—turbulent or "eddie" (sic) components that would be associated with these little droplets.

There is also another force, surface tension. Surface tension would tend to allow the film to remain with the [85] rest of its film, not to detach. This is characteristic of water. But for anybody who has made an analysis on a technical basis, this force is so low it almost can be neglected.

I just wish to put it in for the sake of the record that these are forces that do exist.

So, you see, it becomes a complicated matter now to balance various forces, types of forces. But here we have in the design presented and the patent presented by Burns, we at least have this balance on the inner surface of the outer tube, because here we have countering these other forces that I have been talking about, we have this centrifugal force. There is one final force that is very very important here, and that is the force that is imparted by virtue of the air that is coming into the—coming into this tube—passes, gas passing through this tube.

Now, depending upon the way that gas would reinforce or destroy the water would either peel off and the unit will become inoperative, or not.

The Court: That is why you say here, or has been said, I think, by the previous witness, that the so-called expansion of air is very important in order to prevent the peel off and make the water remain on the surface of the inner tube; is that right?

[86] The Witness: Yes, Your Honor.

There is one other force.

The Court: The exterior surface of the inner tube.

The Witness: That is right.

In this inner tube, you see, if we took the same force diagram, what would we find? We would find that the centrifugal force acts in the same direction as the electrostatic force, these both being very large forces now—the electrostatic force is reasonably large because you can see this is the very basis upon which we are precipitating materials, and so obviously this force has to be designed to be as large as possible. Now, if we then have concurrent forces opposite or tending to peel the water away, what are the balancing forces, the chance small forces of the "eddies"? (sic) Well, if anything, they would disrupt more. On a statistical basis they would disrupt partially, and in other cases not so.

The Court: You are still making a distinction between the application here and Burns.

The Witness: I am making this distinction, Your Honor: Burns never anticipated or could not even attempt this type of solution. What I am trying to do now, I am drawing the forced diagram on a particle of water on the outer surface of [87] the inner cylinder to help, if this does help, in the understanding of what the forces are on this particle, and how the contribution made in the present claim and application is relevant, very relevant, to this particular case now.

It would appear to me that if one analyzes on a technical basis, and it is—this is on a very simple technical basis, it would be immediately evident to one skilled in the art that it would not be possible, it would absolutely not be possible to use any of the concepts of the Burns patent here, for the sustenance of water in a concentric system. And my sole point here would be that there had to be some major breakthrough that would take place, a new force applied in a new way which would allow the uniformity of film that is essential for a wet precipitator, electrostatic precipitator and concentric cylinders.

The Court: What was the new force applied?

The Witness: The new force applied in a new way was the behavior of the force of the gas as it came through a venturi and expanded with very definite design as to how it expanded, controlled behavior.

By Mr. Calimafde:

Q. Let me ask you one or two more questions, Doctor Spector.

In regard to the combination of reference as [88] suggested by the Patent Office, we have Burns who teaches us how to apply water to the outer tubular member. A. Yes.

Q. And, in fact, the application of water to our outer cylinder is similar to Burns, isn't that so? A. That is true.

Q. Now, suppose one skilled in the art applied water as suggested by Burns to the inner cylinder? Would he have an operative device? A. He would not.

Q. If he applied that water, instead of in a circular direction, downwardly, and then turned on the gas in the Nesbit fashion, not in the de Seversky fashion, just applied gas as Burns applies it or Nesbit applies it, what would that gas do, if anything, to the water on the opposing surfaces of the— A. Be completely disruptive and probably cause spark-off, break down, in the operation of the device.

Q. Is that what I have been referring to as peel-off? Would the gas peel the water off? A. Yes. I don't like the term, personally, if you don't mind, but this is the effect.

The Court: I thought that peel-off was the [89] separation of droplets of water by consequence of the action of centrifugal force—it would happen in greater measure.

I am not making myself very clear.

I understood the term "peel-off" meant exactly what I said. In the use of the apparatus as indicated by Burns you have that in large measure. In other words, it would be disruptive for the whole purpose.

The Witness: Yes. Your understanding is correct, Your Honor. My question is this: it is the technicality of the term "peel-off." I am using, as long as the term was brought up—using it in the sense that anything that would take a particle of water from the main stream of film—

The Court: I understand that. I want you gentlemen to understand, both sides, when you use terms that I am not familiar with artistically—

The Witness: Yes.

The Court: —I am familiar with generically speaking, I want to be sure I get the artistic view.

The Witness: Yes.

By Mr. Calimafde:

Q. Is it your testimony, then, Doctor Spector, that Major deSeversky made operative what would have been inoperative [90] if combined as suggested by the Examiner? A. Yes, sir.

Q. And he made it operative by applying the gas in an expanding fashion to this chamber? A. Yes.

Q. Have you read the Penney, et al, patent? A. Pardon?

Q. The Penney patent? A. Yes, I have.

Q. Tell us briefly what the Penney patent discloses. A. The Penney patent discloses a recirculating scheme on a parallel plate precipitator, but I would like to point out—I think that something was said earlier—may I make these suggestions at this time in answering the question?

Q. Yes. A. As this was brought out earlier, it appeared that the recirculating scheme, where it had not been noted, at least, the recirculating scheme only took effect when the device was what we call down in the trade, turned off.

Q. You are talking about Penney. A. The recirculation did not take place when the device was operating, and it is considerably important, I think, to understand that this is one of the really economic [91] considerations in the cleansing of the device—and one of the major considerations.

Let me go one step further: if recirculation were applied in this manner, once a tar is built up on a plate the difficulty in removing that tar with the water system is extraordinary—one can't do it, as a matter of fact. The water just flies over. It requires some soap or alkali, or some hydroxide to enable the mixing of this and the cleansing, and in many cases would have to be scraped. So I state again the recirculation part of it, if you consider just the fact that it is recirculation which to me, again, in my very naive way, is difficult to conceive as something which is patentable. Somebody recirculating water, done with a pump since time immemorial, unless it is applied in a particular application, and the application in the Penney application is applied only when the device is not operating.

Q. And when is this applied in the DeSeversky application? A. Continuously.

Q. Direct your attention to Claim 20 on appeal which appears on the lefthand part of this chart. What language in Claim 20 defines a venturi tube application? A. It is defined in "B" and, in my opinion, although it has not been noted by others, also in "D." But let me [92] confine myself to "B" to begin with.

"Means coupled to a well to draw liquid therefrom and to feed the liquid to the upper end of said tubes to produce a downwardly flowing and substantially uniform liquid film on—" and I would underline that—I would have put that in red—"liquid film on those surfaces of said inner and outer tubes which line said passage." There, too, I would put "inner" in red.

Now, that is one of the elements. The other one which I think goes hand in hand that we have been talking about, I would draw attention to "D."

"Inlet means to introduce said contaminated gas into the lower end of said annular passage between said troughs."

Now, both "B" and "D" clearly, and taken together, clearly indicate the nature of the concern with the method or the means of introducing to avoid just the type of problems we have been talking about.

Q. Let's take those two separately. "D" calls for inlet means to introduce the dirty gas into this unit. A. Yes.

Q. So "D" in itself does not distinguish between [93] the venturi application or any other application? A. No.

Q. "D" simply says apply dirty gas to the precipitator; isn't that correct? A. That is true.

Q. Now, "B" says that we use some means to produce a downwardly flowing and substantially uniform liquid film. A. Yes.

Q. Is it your testimony that we get a downwardly flowing uniform liquid film only by venturi application of gas? Is that your testimony? A. Yes, it is.

Mr. Calimafde: I have no further questions.

The Court: Mr. Nakamura.

Cross-Examination

By Mr. Nakamura:

Q. Doctor Spector, do you have before you the Burns patent which is Defendant's Exhibit 1-A? A. Yes, I do.

Q. Turning to Figure 4— A. I have that before me.

Q. —do I understand correctly that you testified because Number 17 ends in a discontinuity you do not get a [94] venturi effect? A. You understood correctly. You get a combined effect which is turbulence, which is one tried to pull out in terms of venturi, by analysis, plus some turbulent factor, would leave this turbulent factor which would be disruptive. In other words, you get constriction. And the point that was made before that there would be some subsequent expansion of the gas, the answer is sure, there would be some subsequent expansion of the gas. But I would like to point out that the expansion would be non-uniform, would be turbulent, would be disruptive.

Q. Doctor, do I understand, then, that a discontinuity of the type shown by Burns would cause, would not give you a venturi effect? A. Of the type shown by Burns, yes. If it is this type of discontinuity, by all means. Now, one could effectively—by design, and essentially coming back

to venturi, one could effectively control the behavior of it, but not as shown here. And, furthermore, as you are aware, no claim has been in this direction here, because there was unawareness of it.

Q. Doctor, do I understand, then, that in order to get a venturi effect you would have to eliminate this discontinuity—

[95] The Court: Eliminate what?

By Mr. Nakamura:

Q. By eliminating the discontinuity.

The Court: I lost you. You went downstairs. Eliminate what effect, did you say?

Mr. Nakamura: Would the reporter please read back my question?

(Question read by the reporter.)

The Court: What continuity?

Mr. Nakamura: Discontinuity.

The Court: Dis—discontinuity.

It must be me. All right.

The Witness: Venturi is a very special effect. It is not a question of eliminating discontinuity. The point before the Court here is that this is not a venturi. You do not have a venturi here. If you wish to take another half of this and put it on the other side with the flaring end in the other direction there, and if you wish to insert a venturi, well then, insert one, but at least you should show that this is so. This was not discussed. This is not a venturi. It is not a question of just the elimination of turbulence that would cause a venturi. I could show you a thousand systems, a straight pipe being one, a cylinder which is not a venturi and not [96] discontinuous within the confines of the pipe—the point is that this is not a venturi.

The Court: Suppose someone concerned with the problem of the applicant here would read this Burns patent and see

the design. Would he conclude as a consequence, looking at Figure 4 and the general purport of the application, that the matter in which he was interested could be solved by creation of a venturi?

The Witness: No, he would not.

The Court: Would it suggest a venturi to him?

The Witness: No, it would not suggest a venturi. As a matter of fact, in the course of time, and for fifty years it did not suggest a venturi to anybody, and this has been a very critical problem. It required some type of a major breakthrough, where it finally dawns—a gestaldt, as we like to phrase it sometimes in our scientific terminology.

The Court: Gestaldt?

The Witness: Gestaldt, German, G-e-s-t-a-l-d-t, I guess—

The Court: I thought it was, but I wanted to make sure. All right.

Venturi has been known in physics for years, hasn't it?

[97] The Witness: They have been known as such for years, but what we have here is not just a venturi. It is a venturi system in combination with the concentric wet cylindrical type of operation which is designed—and, as I said, the design—the behavior of—the mere conception of this design, which over a period—considerable period of time has not been solved—the behavior of this (indicating) using this venturi principle here was used to solve a force diagram of water, which was extraordinarily difficult because what we have here are at least a couple of elements of quasi-turbulence which are not solvable by usual mathematical designs, and require in some cases almost an empirical solution.

The Court: When you say "usual mathematical design," you refer to design 17 in Figure 4?

The Witness: I am referring to—well, you asked me, Your Honor, a little while ago whether it would not have been obvious that a venturi should have been placed by somebody skilled in the art—

The Court: Faced with the same problem.

The Witness: And my answer is it would not have been obvious and, in effect, has not been obvious for the simple reason that it is difficult to conceive of a particular type of circumstance like a venturi invention or application to a [98] situation which involves turbulent and quasi-turbulent factors. This had to come by—or did come about by a long series of experiences which finally resulted in the invention, or the idea of the application of this type of force suitably applied in a particular—in this particular configuration. From this diagram itself it could not have been obvious, was not obvious, it did not happen.

By Mr. Nakamura:

Q. Doctor Spector, would you turn, please, to the Penney patent, Defendant's Exhibit 1-C? A. Yes, I have it.

Q. Will you refer to the written part of this patent, Column 7?

The Court: What page?

The Witness: What page?

Mr. Nakamura: Your Honor, there is no page number. I have to go by Column—Column 7.

The Witness: Yes, I have it.

By Mr. Nakamura:

Q. Will you come down to Line 24?

The Court: Line what?

Mr. Nakamura: 24.

By Mr. Nakamura:

Q. And read that paragraph, please?

[99] The Court: Beginning with, "If the cleaning of the dust collecting electrodes is to be accomplished without—"

Mr. Nakamura: Yes, Your Honor.

The Witness: "If the cleaning of the dust collecting electrodes is to be accomplished without interrupting the cleaning of the flowing gas normally closed manually operable switch may be opened for preventing

ionization of the relay and constant interruption of the circuits 122 and 124 for the blower motor 6 and the power pack 126 respectively. This is the manner in which we prefer to operate the apparatus."

This is the manner in which no apparatus is operated, including the Chicago system, which uses this type of system and—

The Court: All he asked you was to find the reference to the patent. He hasn't asked the question yet, have you? We will strike anything that was said after the reference was made in the question raised by counsel for the Patent Office. The witness has found the reference and he has read it. It is in the record.

[100] By Mr. Nakamura:

Q. Doctor Spector, would you change your testimony, your direct testimony on the Penney patent in any way now? A. Let me refer to this and read this article with a little greater detectableness. (Pause.)

Yes, I would say at this point that he has now admitted the possibility and even states, and Penney even states that he would like to have the desirability of operating in this manner. Yes, sir.

Mr. Nakamura: I have no further questions, Your Honor.

Mr. Calimafde: Just one question.

Redirect Examination

By Mr. Calimafde:

Q. Doctor Spector, does the prior art suggest the application of a venturi expanding gas to an electrostatic precipitator of any kind? A. It does not, sir.

Mr. Calimafde: No further questions.

The Court: You may step down, sir.

Mr. Calimafde: We rest our case, Your Honor.

The Court: Well, I don't suppose there is going to be any suggestion of argument is there, unless you want to?

[101] Mr. Calimafde: Only if you would like it, Your Honor.

The Court: I don't think it is necessary. The man has gone into detail and you have had a very fine presentation, and I have the record before me, the patent, and all of that.

Do you want to argue?

Mr. Nakamura: Does Your Honor wish it?

The Court: I don't wish it, but I don't want in any way to inhibit you, either of you, from doing it.

Mr. Nakamura: We rest, also, Your Honor.

Mr. Calimafde: Do you wish a brief?

The Court: I have your file brief here, and I have your memorandum of law. I don't think anything further is necessary unless you conclude that it is.

I merely want to make the observation that you made the differentiation between Burns and Nesbit and Penney and has been clarified from your point of view, and Mr. Nakamura from the Patent Office made the suggestions he desired to make in cross-examination, and I think that we have it, and the essence of the business seems to me is the use of the venturi, fundamentally. There are other details, of course, very important in the aggregate. And you make the point that Figure 4 of 17 [102] of Burns indicates a venturi, or an instrument of that character; isn't that right?

Mr. Nakamura: At least as much as the applicant's own prior patent did.

The Court: In other words, it is the suggestion that if you read Burns, you read Nesbit, and you read Penney, and you come up with the answer—you may just come up with it from your point of view. His point of view is decidedly the opposite. You don't come up with it.

Mr. Calimafde: That is correct, Your Honor.

Mr. Nakamura: There is one point. May I answer to his memorandum of law? There is a point of law that I think ought to be brought out.

The Court: I am going to be on motions tomorrow, the next day and, God willing, the next day and the next day. I don't know what is going to come up. I am not going to touch this for a little while—a week or ten days. I may look at it over Thanksgiving. So that will give you time. How much time do you want?

Mr. Nakamura: Would a week be ample?

The Court: A week is fine. Do you want to give him a week on it?

Mr. Calimafde: Yes.

[103] The Court: When you get ready submit your memorandum, and if you want to submit a counter memorandum, you may do it.

Mr. Calimafde: Thank you, Your Honor.

The Court: Very good.

(Thereupon, at 3:00 p.m., the above proceedings were concluded.)

[Filed January 24, 1968]

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

Civil Action No. 2344-66

ALEXANDER P. DESEVERSKY, *Plaintiff*,

v.

EDWARD J. BRENNER, Commissioner of Patents, *Defendant*.

Memorandum Opinion

This is an action brought under 35 USC 145 requesting the Court to enter a judgment that the plaintiff is entitled to receive a patent for an invention as defined in Claim 20 of his application. The application contained other claims which are not relevant to this proceeding. In essence, the invention as defined by Claim 20 relates to an electrostatic precipitator for cleaning contaminated or polluted air and

in which the walls of the precipitator are continuously cleaned by a uniform film of flowing water.

The Claim was rejected by the Patent Office as unpatentable over *Burns*—Patent No. 1,250,088 dated December 11, 1917; *Nesbit*—Patent No. 1,357,202, dated October 26, 1920; and *Penney et al.*,—Patent No. 2,448,046, dated Aug. 31, 1948.* The rejected Claim reads as follows:

> "20. An electrostatic precipitator for cleaning contaminated gas comprising:
>
> (a) concentrically-arranged inner and outer collector tubes defining a vertically disposed annular gas passage,
>
> (b) means coupled to a well to draw liquid therefrom and to feed the liquid to the upper end of said tubes to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage,
>
> (c) concentrically-arranged troughs at the lower ends of said tubes to receive the downwardly flowing liquid therefrom and to discharge the liquid into said well,
>
> (d) inlet means to introduce said contaminated gas into the lower end of said annular passage between said troughs,
>
> (e) a discharge electrode structure supported within said passage,
>
> (f) means to apply a high voltage between said discharge electrode structure and both of said tubes to cause migration of particles in said gas toward the films on said tubes and thereby produce a clean gas, and

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* Not July 6, 1945 as stated on p. 2 of Plaintiff's Trial Brief.

(g) outlet means at the upper end of said annular passage to discharge the clean gas into the atmosphere.

The Court agrees with the Patent Office that *Burns* discloses the concept of the wet precipitator utilizing flowing liquid film as an electrode, and that this is old in the art, and that *Nesbit,* while it relates to a dry rather than a wet precipitator yet encompasses the broad teaching of an annular gas flow passage and precipitator devices in general. *Penney* also teaches the recirculation of the liquid used in the wet precipitator.

In order to overturn the ruling of the Patent Office, the applicant faces initially the proposition that great weight attaches to its expertise and its findings on the issue of obviousness. This is particularly true in highly technical matters such as we have here, unless new evidence is presented which brings about thorough conviction that the ruling of the Patent Office was incorrect. "Thorough conviction" are the words used by the Court of Appeals.[1] See generally, *Morgan* v. *Daniels,* 153 U.S. 120, 125 (1894) (priority of invention); *California Research Corp.* v. *Ladd,* 123 U.S. App. D.C. 60, 356 F.2d 813 (1966). The Court is convinced this burden has not been met and the result achieved by the applicant merely a product of mechanical skill rather than that of the inventive faculty.

Judgment for the defendant. Counsel will prepare findings of fact and conclusions of law, and order accordingly.

MATTHEW F. MCGUIRE
Matthew F. McGuire
United States District Judge

January 24, 1968

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[1] National Distillers & Chemical Corp. v. Brenner, — U.S. App. D.C. — (1967), Footnote 1, p. 3, Opinion No. 20,932, decided December 14, 1967.

Findings of Fact

1. Plaintiff Alexander P. DeSeversky brought this action under Section 145 of Title 35, United States Code, seeking to have the Court authorize the issuance of a patent containing claim 20 of his application, Serial No. 53,255, filed August 31, 1960, entitled "Wet Electrostatic Precipitator". Four other claims in said application have been allowed by the Patent Office.

2. The application in suit relates to an electrostatic precipitator for cleaning contaminated or polluted air, in which the walls of the precipitator are continuously cleaned by a uniform film of flowing water. Claim 20 defines the precipitator as follows:

> 20. An electrostatic precipitator for cleaning contaminated gas comprising:
>
> (a) concentrically-arranged inner and outer collector tubes defining a vertically disposed annular gas passage,
>
> (b) means coupled to a well to draw liquid therefrom and to feed the liquid to the upper end of said tubes to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage,
>
> (c) concentrically-arranged troughs at the lower ends of said tubes to receive the downwardly flowing liquid therefrom and to discharge the liquid into said well,
>
> (d) inlet means to introduce said contaminated gas into the lower end of said annular passage between said troughs,
>
> (e) a discharge electrode structure supported within said passage,
>
> (f) means to apply a high voltage between said discharge electrode structure and both of said tubes to

cause migration of particles in said gas toward the films on said tubes and thereby produce a clean gas, and

(g) outlet means at the upper end of said annular passage to discharge the clean gas into the atmosphere.

3. The Patent Office Board of Appeals affirmed the examiner's rejection of claim 20 under 35 U.S.C. 103 as unpatentable over United States patents to Burns, No. 1,250,088 (1917), Nesbit, No. 1,357,202 (1920) and Penney et al., No. 2,448,046 (1948).

4. The Burns patent, No. 1,250,088, discloses the concept of a wet precipitator utilizing a flowing liquid film as an electrode and shows that this concept is old.

5. The Nesbit patent, No. 1,357,202, while it relates to a dry rather than a wet precipitator, yet encompasses the broad teaching of an annular gas flow passage and precipitator devices in general.

6. Penney et al., in their patent No. 2,448,046, teach the recirculation of the liquid used in a wet precipitator.

7. It would constitute merely an obvious following of Nesbit's teaching to modify the Burns device to provide it with a gas flow passage of annular rather than purely cylindrical configuration. In the light of the modification involved, and the troughs shown by Burns for collecting and discharging the liquid films, concentric troughs, one for each tubular film, would be logically expected.

8. In view of the Penney et al. patent, it would be an obvious expedient to provide the Burns device with means for recirculating the liquid used therein.

9. Claim 20 involves highly technical matters, and the new evidence introduced by plaintiff at the trial fails to carry thorough conviction that the Board of Appeals erred in

finding that claim 20 presents nothing patentable over the prior art.

10. The differences between the subject matter of claim 20 and the prior art are such that the subject matter as a whole would have been obvious at the time the claimed subject matter was devised to a person of ordinary skill in the art; the result achieved by the applicant is merely a product of mechanical skill rather than that of the inventive faculty.

Conclusions of Law

1. In trials *de novo* under 35 U.S.C. 145, great weight attaches to the expertise of the Patent Office and its findings on the issue of obviousness, particularly in highly technical matters, and the decision of the Patent Office will not be overturned unless new evidence is introduced which carries "thorough conviction" that the Patent Office erred. *National Distillers & Chemical Corp.* v. *Brenner,* U.S. App. D.C. , 156 USPQ 163 (1967), Opinion No. 20,932, decided December 14, 1967; *California Research Corp.* v. *Ladd,* 123 U.S. App. D.C. 60, 356 F.2d 813 (1966); *Morgan* v. *Daniels,* 153 U.S. 120, 125 (1894).

2. Claim 20 is unpatentable under 35 U.S.C. 103.

3. Plaintiff is not entitled to a patent containing claim 20 of his application, Serial No. 53,255.

4. The complaint should be dismissed.

.....
Judge

Motion Under Rule 59(a)(2) for a New Trial and To Amend the Judgment and Further To Hold the Case Until the Patent Office Decides Certain New Issues.*

Plaintiff, Alexander P. DeSeversky, moves the Court under Rule 59(a)(2) of the F.R.C.P. for a new trial and to amend its Judgment for the following reasons:

1. On January 24, 1968 this Court filed its Memorandum Opinion, in effect, affirming the rejection of a patent claim on the ground that plaintiff had not carried his burden of showing with "thorough conviction" that the ruling of the Patent Office was incorrect.

2. On February 19, 1968, this Court signed the Findings of Fact and Conclusions of Law submitted by defendant; paragraph 9 of the Findings states that claim 20 (the rejected claim) involves highly technical matters and the new evidence introduced by plaintiff failed to carry the thorough conviction required to, in effect, reverse the Patent Office Board of Appeals.

3. Certain basic issues were presented to this Court in the *de novo* proceeding which were not previously presented to the Patent Office Board of Appeals, and accordingly under the authority of *California Research Corporation* v. *Ladd,* 356 F.2d 816 (U.S. App. D.C. 1966), the presumption of correctness is not available where an issue was not the subject of a Patent Office finding.

4. Under the aforementioned authority and *International Standard Electric Corporation* v. *Ooms,* 157 F.2d 73 (U.S. App. D.C. 1946), this Court may hold this case until the Patent Office decides the issues which were presented for the first time to this Court. This motion is based on the

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* Although Rule 59(a) is entitled "New Trials", we are not actually requesting a new trial as generally understood. As is explained in the memorandum, we are requesting the Court to hold the case and permit plaintiff to obtain findings from the Patent Office as to certain issues.

accompanying memorandum and affidavit of John M. Calimafde.

Respectfully submitted,

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Memorandum in Support of Plaintiff's Motion Under Rule 59(a)(2) for a New Trial and To Amend the Judgment and Further To Hold the Case Until the Patent Office Decides Certain New Issues

PRELIMINARY STATEMENT

Findings of Fact and Conclusions of Law was signed in this case in favor of defendant on February 19, 1968. A Memorandum Opinion was filed by this Court on January 24, 1968 in which it adopted the reasons of the Patent Office for rejecting claim 20*.

The rationale of this Court's opinion is expressed on page 2 thereof which reads as follows:

> "In order to overturn the ruling of the Patent Office, the applicant faces initially the proposition that great weight attaches to its expertise and its findings on the issue of obviousness. This is particularly true in highly technical matters such as we have here, unless new evidence is presented which brings about thorough conviction that the ruling of the Patent Office was incorrect. "Thorough conviction" are the words used

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* For the convenience of the Court, a copy of the Memorandum Opinion and Findings of Fact and Conclusions of Law are attached to this memorandum.

> by the Court of Appeals.[1] See generally, *Morgan* v. *Daniels,* 153 US 120, 125 (1894) (priority of invention); *California Research Corp.* v. *Ladd,* 123 US App DC 60, 356 F.2d 813 (1966). The Court is convinced this burden has not been met and the result achieved by the applicant merely a product of mechanical skill rather than that of the inventive faculty."

[1] National Distillers & Chemical Corp. v. Brenner, — U.S.App.D.C. — (1967), Footnote 1, p. 3, Opinion No. 20,932, decided December 14, 1967.

This motion is bottomed on the ground that certain vital issues were presented to the Court for the first time in this *de novo* proceeding and were never considered by the Patent Office. As we shall explain more fully, the presumption of correctness which requires showing of thorough conviction for reversing an administrative ruling applies only to those issues determined by the administrative tribunal. This Court has the authority to hold this case until the Patent Office reviews these issues with its expertise and special skills. We shall endeavor to demonstrate that it is in the interests of justice for this Court to exercise its authority to hold the case and to obtain a ruling from the Patent Office on these certain issues which are vital to the issue of patentability of claim 20.

Discussion

It is recalled that the invention defined by claim 20 is directed to an electrostatic precipitator consisting of two concentric tubes. The invention resided specifically in the application of water to the opposing faces of the tubes. The application and retention of water by the inwardly curved surface of the outer tube presented no problem because of the manner in which the water was applied to the surface. The water was applied tangentially so that its natural tendency was to adhere to and remain on the surface of the outer tube. The Burns patent disclosed this feature of applying water to the inwardly curved surface

of a tube. It is also recalled that the Nesbit patent discloses two concentric tubes but both of which were dry. The third patent to Penney disclosed a flat plate precipitator which can be operated in the wet or dry state.

The crux of plaintiff's invention was the solution to the problem of how to retain the water on the outwardly curved surface of the inner cylinder. Plaintiff presented two witnesses, Major DeSeversky and Doctor Spector, both authorities in the field of air pollution. Major DeSeversky testified that for many years he tried to solve the problem* but with no success because the water on the inner tube had the natural tendency to splash off the surface and to be attracted to the high voltage electrodes which caused breakdown of the equipment. This evidence was never presented to the Patent Office. DeSeversky testified on the problem of the water being "peeled" off the tube by the gas which travels in the space between the tubes at very high velocity. The several problems which DeSeversky encountered, the specific reasons for the problems and the many years that he searched for a solution to the problem were never presented to the Patent Office and were presented to this Court for the first time in this *de novo* proceeding.

Both DeSeversky and Doctor Spector testified that the problem of how to retain the water on the inner tube was solved only by expanding the gas as it was admitted into the chamber between the tubes. The specific means disclosed by DeSeversky for expanding the gas is the venturi slot at the inlet of the precipitator. This evidence was never presented to the Patent Office but was presented for the first time to this Court. Both DeSeversky and Doctor Spector testified at length during their cross-examination on the vital importance of the expanding gas and the fact

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* We have been unable to obtain from the court reporter the trial transcript; we are informed that there has been generally a delay in the transcription of trial records in the court. It is believed that the Court will recall the testimony which is referred to in the brief.

that neither Burns nor any of the other references disclosed an expanding gas or a venturi inlet to the precipitator.

Succinctly, the issues presented by plaintiff for the first time in this Court were:

1. That extensive research and experimentation demonstrated that the mere application of water to a dual tube precipitator would not produce an operable structure; indeed, the experimentation proved that the mere application of water produced an inoperable structure.

2. That the water applied to the outwardly curved surface of the inner tube could be retained on the surface only by admitting an expanding gas to the chamber between the tube surfaces.

The evidence presented to this Court on both of those new issues was not in dispute. Both witnesses testified unequivocally that not one of the references suggested even remotely the expanding gas concept or the venturi slot inlet.

Applicable Law

The Court of Appeals for this circuit in *California Research Corporation* v. *Ladd*, 356 F.2d 813 (U.S. App. D.C. 1966) enunciated certain principles which are directly in point. In that case, certain new issues were presented to the District Court, and also certain of the evidence presented by the plaintiff in that case was undisputed. The court held that the usual presumption of correctness which attaches to an administrative ruling is not applicable to issues which were not passed upon by the lower tribunal. At page 819, the court said:

> "If the District Court goes ahead with the de novo proceeding, its decision may take into account both the burden of proof that attaches to any plaintiff, and the particular burden inherently resting on a party that seeks to change an administrative result. How-

> ever, the presumption of correctness normally accorded to administrative findings is not available where an issue has not been the subject of a Patent Office finding, or an assumption underlying the Patent Office finding is demonstrably inaccurate in a material degree."

In regard to the procedure which a District Court may follow when new issues are presented to it and which new issues are supported by undisputed evidence, the court said at page 818,

> "Where, however, the explicit assumptions of the Patent Office are contradicted by the undisputed evidence adduced in court, the proof meets at least some of the burden cast on plaintiff by the presumption of correctness. Cf. Stradar v. Watson, 100 U.S.App.D.C. 289, 244 F.2d 737 (1957). Where complicated technical questions are involved and the assumption of the Patent Office is vitiated by the court's ruling, the District Court may stay its proceeding in order to obtain the benefit of the Patent Office expertise in the light of the new condition developed on the record."

If our premise is accurate, namely, that the aforementioned issues were not the subject of the Patent Office Findings (we are confident that defendant will take no issue with this premise as the issues were unquestionably presented for the first time in this proceeding), then the burden of "thorough conviction" should not apply. Further, all the evidence in regard to these two novel issues was uncontradicted and undisputed. To apply a presumption of correctness or a burden of thorough conviction on plaintiff is to impose a strict burden based on assumed Findings where in fact they do not exist. The procedure recommended by the Court of Appeals is, we submit, both fair and logical, and we respectfully request this Court to adopt the procedure in this case. Namely, to hold the case, and to obtain from the Patent Office specific Findings as to these two vital issues. (*International Standard*

Electric Corporation v. *Ooms*, 157 F.2d 73 (U.S. App. D.C. 1946).

CONCLUSION

Although we have entitled the motion as one for a New Trial to comply with Rule 59, we are more accurately requesting the Court to open the judgment, to hold the case, and to permit plaintiff to obtain findings from the Patent Office on two vital issues which, we submit, determine the patentability of claim 20.

As a matter of procedure, if the Patent Office maintains its rejection after consideration of the issues, the Findings of Fact and Conclusions of Law would simply be modified to reflect this consideration; i.e., no new trial proceeding would be required. Alternatively, if the Patent Office finds after consideration of the new issues that the claim is allowable, plaintiff would dismiss its complaint, and again no new trial proceeding would be required.

In view of the finding of fact that the subject matter is highly technical, it is believed that the interests of justice would best be served by obtaining from the Patent Office the benefit of its skill and expertise on these two specific issues.

Respectfully submitted,

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[Filed January 24, 1968]

Memorandum Opinion

This is an action brought under 35 USC 145 requesting the Court to enter a judgment that the plaintiff is entitled to receive a patent for an invention as defined in Claim 20 of his application. The application contained other claims which are not relevant to this proceeding. In essence, the invention as defined by Claim 20 relates to an electrostatic precipitator for cleaning contaminated or polluted air and in which the walls of the precipitator are continuously cleaned by a uniform film of flowing water.

The Claim was rejected by the Patent Office as unpatentable over *Burns*—Patent No. 1,250,088 dated December 11, 1917; *Nesbit*—Patent No. 1,357,202, dated October 26, 1920; and *Penney et al.*,—Patent No. 2,448,046, dated Aug. 31, 1948. The rejected Claim reads as follows:

> "20. An electrostatic precipitator for cleaning contaminated gas comprising:
>
> (a) concentrically-arranged inner and outer collector tubes defining a vertically disposed annular gas passage,
>
> (b) means coupled to a well to draw liquid therefrom and to feed the liquid to the upper end of said tubes to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage,
>
> (c) concentrically-arranged troughs at the lower ends of said tubes to receive the downwardly flowing liquid therefrom and to discharge the liquid into said well,
>
> (d) inlet means to introduce said contaminated gas into the lower end of said annular passage between said troughs,

(e) a discharge electrode structure supported within said passage,

(f) means to apply a high voltage between said discharge electrode structure and both of said tubes to cause migration of particles in said gas toward the films on said tubes and thereby produce a clean gas, and

(g) outlet means at the upper end of said annular passage to discharge the clean gas into the atmosphere.

The Court agrees with the Patent Office that *Burns* discloses the concept of the wet precipitator utilizing flowing liquid film as an electrode, and that this is old in the art, and that *Nesbit,* while it relates to a dry rather than a wet precipitator yet encompasses the broad teaching of an annular gas flow passage and precipitator devices in general. *Penney* also teaches the recirculation of the liquid used in the wet precipitator.

In order to overturn the ruling of the Patent Office, the applicant faces initially the proposition that great weight attaches to its expertise and its findings on the issue of obviousness. This is particularly true in highly technical matters such as we have here, unless new evidence is presented which brings about thorough conviction that the ruling of the Patent Office was incorrect. "Thorough conviction" are the words used by the Court of Appeals.[1] See generally, *Morgan* v. *Daniels,* 153 US 120, 125 (1894) (priority of invention); *California Research Corp.* v. *Ladd,* 123 US App DC 60, 356 F. 2d 813 (1966). The Court is convinced this burden has not been met and the result achieved by the applicant merely a product of mechanical skill rather than that of the inventive faculty.

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[1] National Distillers & Chemical Corp. v. Brenner, —— U.S.App.D.C. —— (1967), Footnote 1, p. 3, Opinion No. 20,932, decided December 14, 1967.

Judgment for the defendant. Counsel will prepare findings of fact and conclusions of law, and order accordingly.

MATTHEW F. McGUIRE
Matthew F. McGuire,
United States District Judge

January 24, 1968

Findings of Fact

1. Plaintiff Alexander P. DeSeversky brought this action under Section 145 of Title 35, United States Code, seeking to have the Court authorize the issuance of a patent containing claim 20 of his application, Serial No. 53,255, filed August 31, 1960, entitled "Wet Electrostatic Precipitator". Four other claims in said application have been allowed by the Patent Office.

2. The application in suit relates to an electrostatic precipitator for cleaning contaminated or polluted air, in which the walls of the precipitator are continuously cleaned by a uniform film of flowing water. Claim 20 defines the precipitator as follows:

> 20. An electrostatic precipitator for cleaning contaminated gas comprising:
>
> (a) concentrically-arranged inner and outer collector tubes defining a vertically disposed annular gas passage,
>
> (b) means coupled to a well to draw liquid therefrom and to feed the liquid to the upper end of said tubes to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage,
>
> (c) concentrically-arranged troughs at the lower ends of said tubes to receive the downwardly flowing liquid therefrom and to discharge the liquid into said well,

(d) inlet means to introduce said contaminated gas in the lower end of said annular passage between said troughs,

(e) a discharge electrode structure supported within said passage,

(f) means to apply a high voltage between said discharge electrode structure and both of said tubes to cause migration of particles in said gas toward the films on said tubes and thereby produce a clean gas, and

(g) outlet means at the upper end of said annular passage to discharge the clean gas into the atmosphere.

3. The Patent Office Board of Appeals affirmed the examiner's rejection of claim 20 under 35 U.S.C. 103 as unpatentable over United States patents to Burns, No. 1,250,088 (1917), Nesbit, No. 1,357,202 (1920) and Penney et al., No. 2,448,046 (1948).

4. The Burns patent, No. 1,250,088, discloses the concept of a wet precipitator utilizing a flowing liquid film as an electrode and shows that this concept is old.

5. The Nesbit patent, No. 1,357,202, while it relates to a dry rather than a wet precipitator, yet encompasses the broad teaching of an annular gas flow passage and precipitator devices in general.

6. Penney et al., in their patent No. 2,448,046, teach the recirculation of the liquid used in a wet precipitator.

7. It would constitute merely an obvious following of Nesbit's teaching to modify the Burns device to provide it with a gas flow passage of annular rather than purely cylindrical configuration. In the light of the modification involved, and the troughs shown by Burns for collecting and discharging the liquid films, concentric troughs, one for each tubular film, would be logically expected.

8. In view of the Penney et al. patent, it would be an obvious expedient to provide the Burns device with means for recirculating the liquid used therein.

9. Claim 20 involves highly technical matters, and the new evidence introduced by plaintiff at the trial fails to carry thorough conviction that the Board of Appeals erred in finding that claim 20 presents nothing patentable over the prior art.

10. The differences between the subject matter of claim 20 and the prior art are such that the subject matter as a whole would have been obvious at the time the claimed subject matter was devised to a person of ordinary skill in the art; the result achieved by the applicant is merely a product of mechanical skill rather than that of the inventive faculty.

CONCLUSIONS OF LAW

1. In trials *de novo* under 35 U.S.C. 145, great weight attaches to the expertise of the Patent Office and its findings on the issue of obviousness, particularly in highly technical matters, and the decision of the Patent Office will not be overturned unless new evidence is introduced which carries "thorough conviction" that the Patent Office erred. *National Distillers & Chemical Corp.* v. *Brenner,* ... U.S. App. D.C. ..., 156 USPQ 163 (1967), Opinion No. 20,932, decided December 14, 1967; *California Research Corp.* v. *Ladd,* 123 U.S. App. D.C. 60, 356 F.2d 813 (1966); *Morgan* v. *Daniels,* 153 U.S. 120, 125 (1894).

2. Claim 20 is unpatentable under 35 U.S.C. 103.

3. Plaintiff is not entitled to a patent containing claim 20 of his application, Serial No. 53,255.

4. The complaint should be dismissed.

Judge

Judgment

This action came on to be heard at this term, and thereupon upon consideration thereof, it is this day of , 1968,

ADJUDGED that the complaint be and it is hereby dismissed, with costs against plaintiff.

Judge

Memorandum in Opposition to Plaintiff's Motion Under Rule 59(a)(2) for a New Trial and To Amend the Judgment and Further To Hold the Case Until the Patent Office Decides Certain New Issues

Now comes the defendant, Edward J. Brenner, Commissioner of Patents, and in accordance with the provisions of Local Rule 9(b), opposes the instant motion by plaintiff in the above-entitled civil action on the basis of the POINTS AND AUTHORITIES set forth below.

POINTS AND AUTHORITIES

1. Although the motion is captioned as one for a new trial, plaintiff's memorandum in support of the motion points out that he is "* * * requesting the Court to open the judgment, to hold the case, and to permit plaintiff to obtain findings from the Patent Office on two vital issues * * *" involving evidence introduced by plaintiff for the first time at the trial on the ground that the case involves "highly technical matters".

2. This is an action under 35 U.S.C. 145. Such an action, like the equity suit under the predecessor statute, R.S. 4915, is a trial de novo in which new evidence is commonly introduced which was never before the Patent Office. The trial in the District Court is to be heard upon all competent evidence adduced and upon the whole merits. *The Hoover Co.* v. *Coe,* 325 U.S. 79 (1945); *Zenith Radio Corp.*

v. *Ladd*, 114 U.S. App. D.C. 54, 310 F. 2d 859, 135 USPQ 216 (1962). There is no express statutory authority and no judicial authority for remanding a case to the Patent Office for consideration of new evidence introduced in a proceeding under Section 145, whether or not the case involves highly technical matters. Judicial authority indicates clearly that there is no power to remand.

3. In *Knutson* v. *Gallsworthy*, 82 U.S. App. D.C. 304, 314, 164 F. 2d 497, 74 USPQ 324 (1947), the Court of Appeals, in remanding the cases for further findings of fact by the trial court, noted that "[i]t would obviously be helpful if the trial court * * * could remand the cases to the Patent Office for further findings of fact," but held that it had been "* * * unable to find authority for such a remand in a proceeding under Section 4915." Since no language in 35 U.S.C. 145 has any bearing on remand, it would appear axiomatic that if there was no basis for remand under Section 4915, there is likewise no basis for remand under 35 U.S.C. 145. Moreover, subsequent cases in this Court show clearly that the holding in the *Gallsworthy* case is considered to apply to cases filed under 35 U.S.C. 145. In *Stiller* v. *Watson*, Civil Action No. 3268-60 (D.C.D.C.), this Court, speaking through Chief Judge McGuire in ruling on a motion made by the plaintiff to remand the case to the Patent Office, stated in an unpublished "Memorandum" dated May 29, 1962, that "* * * the Court finds no language in the statute which authorizes such a remand * * *." Similarly, in *General Tire and Rubber Co.* v. *Watson*, 184 F. Supp. 344, 351, 125 USPQ 628 (D.C. D.C., 1960), and in *Jennings* v. *Brenner*, 255 F. Supp. 410, 412, 150 USPQ 167 (D.C.D.C., June 22, 1966), this Court (Holtzoff, J.), alluding to trial testimony which was not before the Patent Office, pointed out again in the *General Tire* case that "* * * this Court is powerless to remand the case * * *," and in the *Jennings* case that:

> Unfortunately, the statute under which these actions are brought does not provide for a remand to the

> Patent Office to enable it to consider the additional evidence. * * * Naturally, * * * the Court has to act within the limitations of the existing law.

4. With reference to plaintiff's reliance on *California Research Corp.* v. *Ladd,* 123 U.S. App. D.C. 60, 356 F. 2d 813, 148 USPQ 404 (February 4, 1966), as authority for a remand to the Patent Office, it should be noted that the Court of Appeals discussed such a remand only as a general proposition, but the fact remains that the Court did not specfically instruct the District Court to consider such a remand of the *California Research* case, nor did the District Court in the subsequent proceeding remand the case to the Patent Office. *California Research Corp.* v. *Ladd,* 260 F. Supp. 752, 151 USPQ 563 (November 15. 1966). Whatever weight might be given to the *California Research* case, it is submitted that the case provides no authority for a remand of the present case. It should further be noted that this view finds support in the opinion in the *Jennings* case, *supra,* which was decided by the District Court on June 22, 1966, several months subsequent to the *California Research* decision.

5. In *International Standard Electric Corp.* v. *Ooms,* 81 U.S. App. D.C. 215, 157 F. 2d 73, 70 USPQ 32 (1946), a case on which plaintiff relies, the Court of Appeals remanded the case "* * * to the District Court with instructions to hold it until the Patent Office decides whether in its opinion * * *" one "skilled in the most relevant art * * * could build appellant's devices from the disclosures." 81 U.S. App. D.C. at 217. Although, after remand to the District Court, the Patent Office gave a second decision in which it decided the question, *International Standard Electric Corp.* v. *Kingsland,* 83 U.S. App. D.C. 355, 169 F. 2d 890, 78 USPQ 241 (1948), it should be noted that this question was the sole issue in the case, and that, as noted in the 1946 decision, the Board of Appeals had originally left the question unanswered as immaterial, and "appellant did not, in the District Court, discharge its burden of proving

that a man skilled in the most relevant art * * * could build appellant's devices from the disclosures." Thus, the circumstances which prompted the remand were most unusual in that the Patent Office had not decided in the first instance, the only issue before the District Court on remand. The circumstances here are readily distinguishable. Here, the basic issue of obviousness has been decided by the Board of Appeals, and plaintiff is merely seeking remand for consideration of new evidence bearing on the Board's decision on that issue. It is to be noted that, under analogous circumstances which arose when the *International Standard Electric* case was on appeal for the third time, the Court of Appeals made no reference to a remand. *International Standard Electric Corp.* v. *Marzall,* 87 U.S. App. D.C. 198, 184 F. 2d 592, 86 USPQ 243 (1950). As pointed out in the dissenting opinion (87 U.S. App. D.C. at 200), the District Court stated that "a calculating machine of a very complex type" was involved.

6. Certain statements made by the Court of Appeals in the *California Research* case, *supra,* have been quoted in plaintiff's memorandum (page 6) as authority for his argument that the burden of "thorough conviction" should not apply to issues presented for the first time in the proceeding before the District Court. Whatever weight is given to those statements, the fact nevertheless remains that the Court of Appeals in so many words held, contrary to plaintiff's view, and in accordance with the weight of authority, that:

> On remand appellants have the burden of satisfying the court on the issue of criticality. Even if that burden is met, appellants will not be entitled to relief unless the court concludes that their proof carries thorough conviction negating obviousness. (123 U.S. App. D.C. at 69).

The issue of criticality referred to above was not raised until after the trial had ended.

7. In the instant case, the problem of operably applying water in a dual tube precipitator, and the solution of admitting an expending gas by means of a venturi slot, are asserted by plaintiff as two new issues presented for the first time in this Court. Since any issues as to the problem and solution thereof were raised by the pleadings (Bill of Complaint for Issuance of a Patent, Paragraph No. 8 and Answer to Complaint, Paragraph No. 8), the question might well be asked why a remand is requested after the Court has decided the case, and was not requested before the decision. In any event, and as indicated in the post-trial "Memorandum For Defendant", the asserted new issues are immaterial to a disposition of the case since the venturi slot which allegedly solved the problem is not expressly set forth in the claim at bar or disclosed in the specification. The Court of Appeals of this circuit has consistently refused to authorize the granting of a patent on a contribution which is not expressly set forth in the claims. *Siegel* v. *Watson,* 105 U.S. App. D.C. 344, 267 F. 2d 621, 121 USPQ 119 (1959); *O'Brien* v. *Watson,* 104 U.S. App. D.C. 407, 262 F. 2d 718, 119 USPQ 485 (1958); *Seyfarth* v. *Coe,* 76 U.S. App. D.C. 96, 129 F. 2d 58, 54 USPQ 61 (1942).

8. Since the proceeding under 35 U.S.C. 145 is a trial de novo which is to be heard upon all competent evidence adduced, since the *Gallsworthy* case and subsequent decisions show that there is no authority for a remand of the case, it is submitted that the motion should be denied.

9. It is understood that counsel for plaintiff has requested an oral hearing on the motion. Counsel for defendant does not join in this request and sees no need therefor; nevertheless, should the Court be disposed to hear argument, counsel stands ready to appear on behalf

of defendant to aid the Court in resolving the issues presented.

Respectfully submitted,

JOSEPH SCHIMMEL
Joseph Schimmel, *Solicitor*
United States Patent Office
Attorney for Defendant

March 6, 1968

Order

This action came on for consideration at this term of plaintiff's motion for a new trial, for amendment of the judgment rendered February 19, 1968, dismissing the complaint, and for the case to be held until the Patent Office decides certain new issues; and thereupon, upon consideration thereof, it is this day of , 1968,

ORDERED that the said motion be and it is hereby denied.

Judge

Plaintiff's Reply Memorandum in Support of Its Motion Under Rule 59(a)(2)

Defendant answered plaintiff's motion by filing a memorandum in numbered paragraph form. For the convenience of the Court in following our reply to the defendant's answer, we shall refer to its numbered paragraphs.

There is no dispute that plaintiff presented for the first time to this Court the question of patentability of the solution of maintaining water on the inner tube of the dual tube precipitator by the application of an expanding gas through a venturi slot. The memorandum filed by defendant does not suggest that this question was decided by the Patent Office.

The question raised by our motion is whether it is equitable to impose a burden of "thorough conviction" on plaintiff in regard to an issue never passed upon by the Patent Office. This Court on page 2 of its Memorandum Opinion correctly stated that,

> "In order to overturn the ruling of the Patent Office, the applicant faces initially the proposition that great weight attaches to its expertise and its findings on the issue of obviousness. This is particularly true in highly technical matters such as we have here, unless new evidence is presented which brings about thorough conviction that the ruling of the Patent Office was incorrect."

The matter presented to this Court is admittedly highly technical. We submit, however, that it is unequitable on a matter raised for the first time before this Court. In our moving papers, we cited *International Standard Electric Corp.* v. *Ooms,* 81 U.S. App. D.C. 215, 157 F. 2d 73, (1946) as authority for this Court to hold the action until the Patent Office decided the specific question. There is no question in that case, the Court did exactly what we are requesting this Court to do.

We shall now reply to the specific paragraphs in defendant's memorandum.

Paragraph one is a preliminary statement involving the basis of our motion and requires no reply.

In Paragraphs two and three, defendant argues that there is no authority for remand under 35 U.S.C. 145. We agree with defendant. Technically, there is no authority or basis for remand because a 35 U.S.C. 145 action is *de novo* in the District Court. That is why we did not address our motion as one to remand the action to the Patent Office. We do not dispute, therefore, defendant's contention that this case may not be remanded to the Patent Office; we contend, however, that under the authority of the *Inter-*

national case, this Court may hold the action and obtain from the Patent Office a finding on a particular issue.

In Paragraph four of the memorandum, defendant discusses the *California Research* case and argues that it has no authority for a remand to the Patent Office. Again we agree with defendant. The *California Research* case was cited for the proposition that the presumption of correctness is not available where an issue has not been the subject of a Patent Office finding. We submit that perforce of logic and fairness, if an issue had not been decided by the Patent Office and the subject matter is highly technical, there is then no underlying basis for the presumption of correctness. We submit the most equitable course is simply to hold the case and obtain from the skilled Patent Examiner a finding on the specific issue of fact. That is the recommended procedure by the Court of Appeals in the *California Research* case.

In Paragraph five of its memorandum, the defendant apparently agrees with plaintiff that in the *International Standard* case, the Court "held" the action and obtained a finding from the Patent Office in regard to a specific issue. The distinction between a remand and the mere holding of the case is not clear from a reading of the cases. We assume, however, that where a court has the authority to remand, it also has the authority to instruct or order. This being a *de novo* proceeding does not vest in the District Court such power. Where, however, the *de novo* proceeding is based on an administrative ruling, it appears from the *International Standard* case that the Court does have the power simply to hold the action and to obtain from the administrative tribunal disposition of certain vital facts on which an ultimate legal conclusion must be rendered by the Court.

In Paragraph six of its memorandum, the defendant quotes from the *California Research* case which superficially appears to support the view that the burden of

thorough conviction remains the same even where the Patent Office had not passed judgment on an issue of fact. We do not read the quote in that way. At 356 F. 2d 819, the Court states specifically that the presumption of correctness normally accorded to administrative findings is not available where an issue was not the subject of the Patent Office finding. This determination is a limitation to the general rule, that an administrative ruling shall not be set aside,

> "* * * unless new evidence is presented which brings about thorough conviction that the ruling of the Patent Office was incorrect."

Manifestly, if the Patent Office has not passed on a factual issue, it is meaningless to argue about a burden which is required to prove the Patent Office wrong. The Court of Appeals in the *California Research* case answered this dilemma in the quote appearing on page 6 of defendant's memorandum by suggesting that the Court must ultimately find that the proof carried thorough conviction to support the legal conclusion that the invention was not obvious. We submit, that is a very different thing from requiring plaintiff to prove with thorough conviction that the Patent Office erred in regard to a specific finding which it never found.

We earnestly believe that we proved with thorough conviction that the invention was unobvious in that the problem waited 50 years for the solution. Despite the thorough cross-examination by the Solicitor, the evidence is without contradiction that the solution was unobvious.

In Paragraph eight of its memorandum, defendant asks the question,

> "Why a remand is requested after the Court has decided the case and was not requested before the decision"?

First, we are not asking for a remand but simply a "holding" of the case until a finding is obtained from the Patent Office. Second, we could not ask for a "holding" previously because plaintiff could not anticipate that the Court would accord a presumption of correctness to a fact not passed upon by the Patent Office.

Finally, in the same paragraph the defendant raises the question of disclosure. This question was fully discussed in our trial reply memorandum. The venturi slot is fully disclosed in plaintiff's co-pending patent.

Paragraph eight of the memorandum repeats again the argument regarding remand and we have fully explained our position in the foregoing pargraphs.

Respectfully submitted,

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Memorandum

With reference to plaintiff's motion under Rule 59(a)(2) for a new trial and to amend the judgment and, further, to hold the case until the Patent Office decides certain new issues, filed February 28, 1968, the motion is denied.

The proceeding was a trial de novo. The Court heard *all* the evidence presented by both parties, including, of course, the viva voce testimony. It decided the case upon its merits and entered judgment. The subject matter simply does not rise to the dignity of invention.

MATTHEW F. MCGUIRE
United States District Judge.

May 3, 1968

H. A. BURNS.

PROCESS AND APPARATUS FOR SEPARATION OF SUSPENDED PARTICLES FROM GASES.

APPLICATION FILED APR. 18, 1914.

1,250,088. Patented Dec. 11, 1917.

Fig. 1.

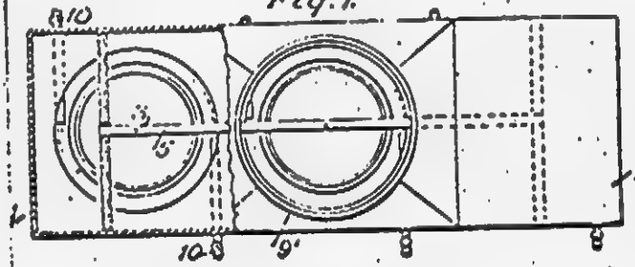


Fig. 5.

Fig. 2.

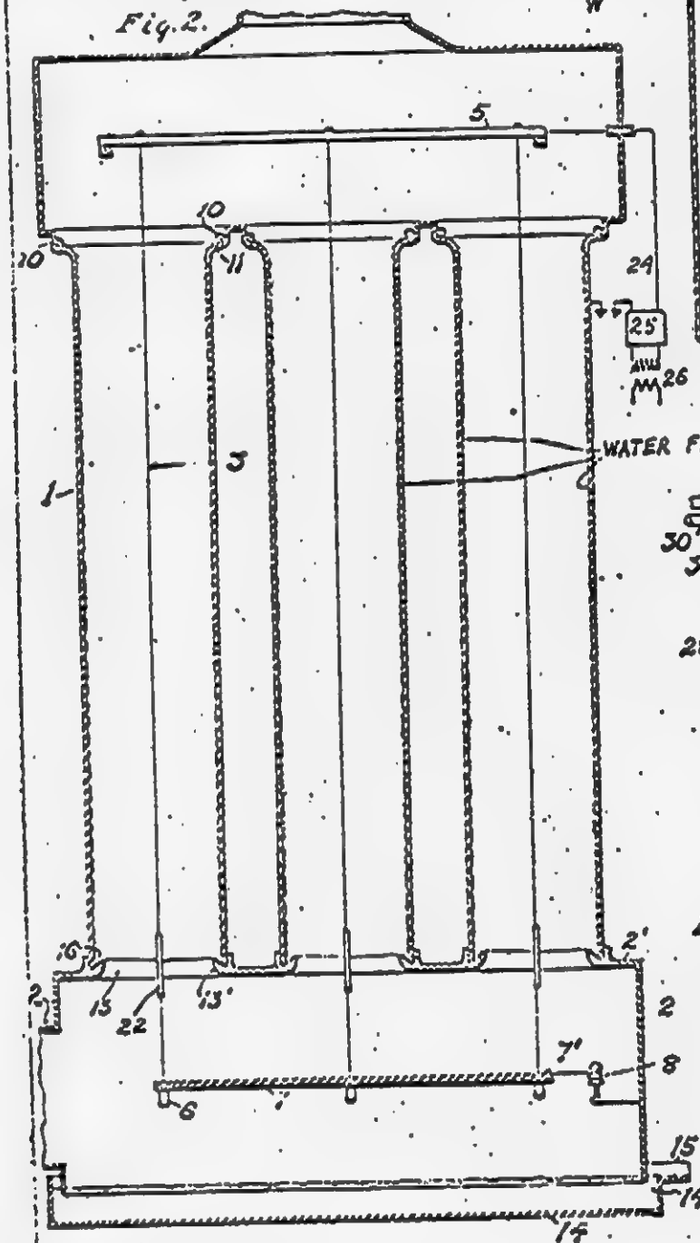


Fig. 6.

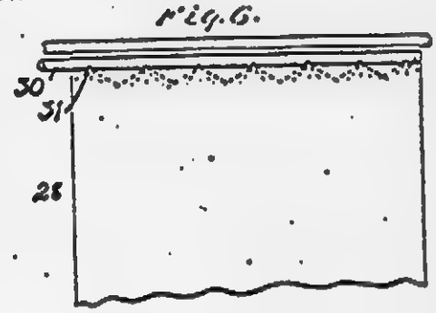


Fig. 3.

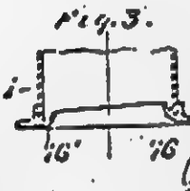
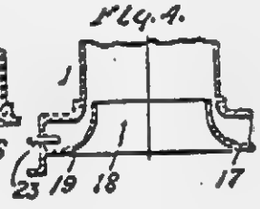


Fig. 4.



Witnesses:
Wm. H. Drew.
Edw. T. Bell

Inventor:
Herbert Alexander Burns
by Arthur P. Knight
Atty

UNITED STATES PATENT OFFICE.

HERBERT ALEXANDER BURNS, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO INTERNATIONAL PRECIPITATION COMPANY, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA.

PROCESS AND APPARATUS FOR SEPARATION OF SUSPENDED PARTICLES FROM GASES.

1,250,088. Specification of Letters Patent. Patented Dec. 11, 1917.

Application filed April 18, 1914. Serial No. 32,892.

To all whom it may concern:

Be it known that I, HERBERT ALEXANDER BURNS, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Process and Apparatus for Separation of Suspended Particles from Gases, of which the following is a specification.

This invention relates to apparatus for separating suspended particles from gases by electrical action. In such apparatus the gas to be cleaned is passed through an electric field in which a silent discharge is maintained, thereby causing the particles to be charged and to migrate under the action of the electric field, transversely to the current of gas, so as to be separated or precipitated therefrom. For effective precipitation it is desirable that the migration should proceed in one direction only or substantially so, and this requires that the electric field shall be unidirectional and that the discharge shall proceed in such manner as to charge all the particles similarly. In order to produce such a discharge, the electrodes between which the discharge is maintained are so constructed as to facilitate discharge from certain of the electrodes, herein referred to as the discharge electrodes, and to minimize the discharge from the other electrodes, herein termed the collecting electrodes. For this purpose the discharge electrodes are formed in such manner as to present relatively small surface and sharp convexity, so that adjacent to such electrodes the electric field is comparatively strong, and correspondingly strong ionizing and discharge effects are produced, and the collecting electrodes are formed with flat or concave surfaces of relatively large extension, so that the field intensity ionization and discharge at such surfaces is comparatively small. It is of great importance that the surface of the collecting electrodes should be smooth, or free from sharp projections or roughness of any kind, since such projections concentrate the electric field adjacent thereto and form centers of ionization and discharge, with the result that the normal migration of suspended particles toward these electrodes is interfered with by the reverse charges imparted to the particles through the ionization of the gas adjacent to the collecting electrodes. I have found that, in many cases, the material precipitated on the collecting electrodes tends to build up thereon, so as to form projections which act as centers of discharge and interfere, in the manner stated, with complete and effective migration of the particles in the gas passing through the apparatus, with the result that a considerable proportion of such particles fail to reach the collecting electrodes and are swept through the apparatus, by the current of gas, without precipitation. An important object of the present invention is to maintain the collecting electrodes in such condition as to present surfaces of minimum roughness so as to avoid, as far as possible, any interference with effective precipitation of the particles. This object I attain by maintaining a film or layer of liquid on the surface of the electrode, so that the surface exposed to the electric field is in effect a liquid surface, which automatically retains a smooth condition. I also prefer to provide for continual movement of the liquid over the surface of the electrode, whereby any material deposited on the electrode is washed away, either by the entraining action of the stream of liquid, or by actual solution of the material in the liquid.

A further object of the invention is to provide, in certain cases, for selective separation of certain constituents of the suspended matter, by solution in such liquid at the collecting electrodes.

Another object of the invention is to provide for separation from the gas being treated, of any constituents capable of absorption in the liquid on the electrodes, either by physical or chemical action.

Other objects of the invention will appear hereinafter.

The invention may be carried out in any suitable apparatus, for example in the apparatus illustrated in the accompanying drawing, wherein:

Figure 1 is a partly broken plan view of a treater having cylindrical collecting electrodes.

Fig. 2 is a vertical section of the treater shown in Fig. 1.

Fig. 3 is a vertical section, transverse to Fig. 2 of the lower portion of the collecting electrodes.

ries away the matter deposited on the electrodes, thereby maintaining the electrodes in clean, smooth condition, so that the precipitating operation proceeds effectively, without interference due to roughening of these electrodes by the precipitated matter. The water or other liquid, carrying the deposited matter, passes away through the outlet means at the bottom of the electrodes, and the cleaned gas passes away through the flue 9.

In case the solid material precipitated from the gas contains a constituent which is soluble in the liquid supplied to the electrode 1, this constituent is taken up in solution in such liquid, and may thereby be removed or separated, not only from the gas, but from the remainder of the solid precipitate, which is allowed to settle, or is otherwise removed from the solution. For example, by treating flue gases containing sugar dust together with water-insoluble dust, in the above described manner, using water as the liquid for the film electrode, I may recover the sugar content of the dust, the solution being drawn off, settled and the sugar recovered therefrom in any usual manner.

My process may also be applied to the separation of gaseous constituents from a mixed gas, in case such constituents are capable of being dissolved in the liquid used, or of reacting with the same to form a soluble compound. This application of the process is of particular advantage when the gas contains dust or solid or liquid suspended matter, in addition to the soluble gaseous constituent. In this connection the operation of the electric field serves not only to precipitate the suspended material, but also aids in the absorption of the gaseous constituent, the gases being forced into contact with the liquid on the collecting electrodes by the action of the electrical wind or convection, proceeding from the discharge electrodes.

By maintaining a liquid film electrode, such as above described, I am enabled to overcome many of the difficulties usually encountered in cleaning gases by electrical action, and the gases can be passed through the apparatus at higher velocity than with solid collecting electrodes under the usual conditions.

Under certain conditions it may not be necessary to maintain the liquid film continuously, the liquid being then supplied intermittently, or from time to time, whenever the accumulation of material on the collecting electrodes is such as to require it. This will be the case, for example, when the amount of precipitated material is small, and it will be particularly the case when the precipitated material is soluble in the liquid used, since in such case any deposit may be readily washed away after it is formed. In case the precipitated material is not capable of being readily dissolved or washed away by the liquid, it is desirable to maintain continuously, a liquid surface at the collecting electrode, to prevent deposition of an adherent coating of such material.

The process may be carried out in apparatus with any form of collecting electrodes. For example, as shown in Figs. 5 and 6, the collecting electrode members 28 may be formed as plates with plane surfaces, and the discharge electrodes 29 as wires hung parallel to such plates. The liquid may be supplied to the collecting electrodes in any suitable manner, the supply means shown in Figs. 5 and 6 being suitable in some cases, and comprising a supply pipe 30 provided with outlets 31 adapted to deliver jets of liquid against the vertical faces of electrode members 28. Under certain conditions, some of the particles carried by the gases under treatment may also be precipitated on the discharge electrodes and my invention may also provide for supply of washing liquid to such electrodes. Thus, as shown in Fig. 5, a nozzle 33 may be provided adjacent each discharge electrode 29, through which water or other cleaning liquid may be supplied, from time to time, to such electrodes, so as to keep the same sufficiently clear of accumulated deposits to maintain maximum efficiency of discharging action of the electrode, the electrical current being shut off while the discharge electrode is being cleaned in this manner.

The liquid supplied to the electrodes may be of any suitable nature. It may be water, or a liquid having special chemical properties enabling it to dissolve certain of the constitutents of the precipitated material, or of the gases. In special cases it may be found advantageous to use materials which are liquid only at temperatures above or below ordinary "room temperatures", and in such cases the apparatus is heated or cooled so as to maintain such material in liquid condition while it is being used for forming a liquid film or layer on the electrode.

What I claim is:

1. The process of separating suspended particles from gases, which consists in passing a current of such gas between a discharge electrode surface, of relatively limited area, and a liquid collecting electrode surface, of relatively extended area, and maintaining between such electrode surfaces, sufficient unidirectional potential difference to produce a discharge from such discharge electrode surface and thereby charge the suspended particles and cause them to move across the current of gas and into contact with the liquid collecting electrode.

2. The process of separating suspended particles from gases, which consists in passing a current of such gas adjacent to a dis-

charge electrode surface, of relatively limited area, maintaining, opposite such discharge electrode, a descending liquid stream of relatively extended area, forming a collecting electrode and maintaining between such electrode surfaces a unidirectional difference of potential to produce discharge from the discharge electrode surface and to cause the particles to thereby become charged and to move across the current of gas into the liquid at the collecting electrode surface, and continually by the motion of the liquid, carrying away the particles so collected by the liquid and to thereby maintain a smooth liquid electrode surface adapted to minimize discharge therefrom.

3. The process of separating from a gas, suspended particles, whose constituents are partly soluble and partly insoluble in a liquid, which consists in maintaining a moving stream of such liquid, of relatively extended area, passing a current of the gas past said stream, passing an electric discharge into said gas to charge the particles, forcing the charged particles into contact with such liquid stream, by the action of an electric field, so as to cause the soluble particles to be dissolved and the insoluble particles to be suspended in such liquid, carrying away the material of the particles by the movement of the liquid, and subsequently separating the soluble from the insoluble material.

4. The process of separating from a gas, a constituent which is soluble in a liquid, which consists in passing the gas adjacent to the surface of a stream of such liquid, and passing an electric discharge through the gas to cause convection of the gas toward the liquid surface so as to bring the gas into effective contact with the liquid.

5. In an apparatus for electrical separation of suspended particles from gases, the combination of liquid supply and distributing means adapted to maintain a moving liquid stream of relatively extended surface, a discharge electrode of relatively small surface arranged opposite the surface of said stream, means for maintaining between such discharge electrode and stream sufficient unidirectional potential difference to produce electric discharge, and means for passing the gas to be treated through such discharge.

6. In an apparatus for electrical separation of suspended matter from gases, an electrode member formed as a vertical pipe, means for supplying liquid tangentially to the upper part of said pipe to form a liquid film electrode at the interior surface of said pipe, and a discharge electrode extending axially in said pipe and insulated therefrom.

7. In an apparatus for electrical precipitation of suspended matter from gases, the combination with collecting electrode means of relatively extended area, and with discharge electrode means of relatively limited area and adapted for the production of discharge therefrom, of means for directing liquid onto the upper part of said discharge electrode means in such manner as to cause the liquid to run down on said discharge electrode means to clean the same.

8. In an apparatus for electrical precipitation of suspended particles from gases, a vertically extending flue, a discharge electrode extending therein, means for passing liquid downwardly along the walls of said flue and means for passing gas upwardly through said flue.

9. In an apparatus for electrical precipitation of suspended particles from gases, vertically extending flue means, header means at top and bottom of said flue means for conducting gas therethrough, the lower header means being provided with a water seal and overflow at its bottom, and discharge electrodes extending within said flue means.

10. In an apparatus for electrical precipitation of suspended particles from gases, the combination with vertically extending collecting electrodes, an insulated support, a plurality of discharge electrodes suspended from said support and extending downwardly past said collecting electrodes, a retaining frame connected to and supported on said discharge electrodes below said collecting electrodes, and insulating means for holding said frame from lateral displacement.

11. The process of promoting chemical or physical action between a liquid and a gas which consists in distributing the liquid over an electrode surface and maintaining an electrical field between such electrode surface and an opposing electrode so as to produce electrical windage and thereby bring the gas in effective contact with said liquid.

12. The process of promoting action between gaseous and non-gaseous materials which consists in distributing said non-gaseous material over an electrode surface and bringing said gaseous material into contact with the non-gaseous material by the action of electrical windage.

13. In an apparatus for electrical separation of suspended matter from gases, an electrode member formed as a vertical pipe having an enlargement forming an annular shoulder at its upper portion, means for supplying liquid to said shoulder to form a liquid film on the inner surface of said pipe, and a discharge electrode extending axially in said pipe and insulated therefrom.

14. In an apparatus for electrical separation of suspended matter from gases, an electrode member formed as a vertical pipe provided with means for supplying liquid

Fig. 4 is a view similar to Fig. 3 showing another construction of the drainage means.

Fig. 5 is a vertical section of a treater having plane electrodes.

Fig. 6 is a side elevation of one of the collecting electrodes shown in Fig. 5.

Referring to Figs. 1 and 2, the treater comprises cylindrical collecting electrode members 1, which may be connected at their lower ends to a header 2, and discharge electrodes 3 which may be formed as fine wires suspended from an insulated support 5 so as to extend axially within the cylindrical electrodes 1. Weights 6 are provided for holding the fine wire electrodes taut, and a spacing frame 7 rests on said weights and is connected by means of a rod 7' to an insulated support 8, so as to retain the fine wire electrodes 3 in proper position. The cylindrical electrode members 1 are preferably arranged so as to extend vertically and they may discharge at their upper ends into the open air, or into a suitable header 9 leading to a flue 9' for conducting away the cleaned gas.

Supply means, such as pipes 10, are provided at the upper part of the collecting electrodes 1, for supplying water or other liquid to said electrodes. These pipes preferably discharge tangentially into the upper part of the electrode members 1, in order to equalize the stream of liquid around the inside of the cylindrical walls of said electrode members, and in order to further equalize such stream, said electrode-members may be enlarged at their upper ends, to form shelves or ledges 11, on to which the liquid is discharged from the pipes 10, so that by the time the liquid reaches the cylindrical body portion of the electrode member it is distributed around the same in a uniform layer or film.

Any suitable means may be provided at the lower ends of the collecting electrodes, for carrying away the liquid flowing from such electrodes. For this purpose, the header 2 connected to the lower ends of the electrode members 1 and to the flue 12 for supplying the gas to be treated may extend below the surface of a body of liquid 14' in a tank 14, having an overflow outlet 15. In order to prevent shortcircuiting action at the spacing means for the discharge electrodes, by the liquid running down from the collecting electrodes, annular troughs 16 may be provided at the bottom of electrode members 1, said troughs being inclined so as to drain the liquid to outlets 16' which are so located that the liquid descends therefrom at a distance from the spacing means 7. Said troughs are formed in a top member 2' for member 2, said member 2' having apertures 13 for passage of the gas into cylindrical members 1, and the walls of these apertures being convexly rounded as shown at 13'. The rounding of these walls 13' and the enlargement of the upper ends of the collecting electrode members 1 tend to minimize the discharge at these places, and in order to further lessen such discharge, enlargements 22 may be provided on the discharge electrodes 3 where they pass the end portions of the collecting electrodes.

As shown in Fig. 4, the spacing means for the discharge electrodes may be protected by a false top or roof 17 extending over the same, and formed with openings 18 for passage of the gas from the header 2 to the collecting electrode members 1, these openings being surrounded by walls 19, for directing the liquid to space above the roof member 17, whence the accumulated material may be removed by drainage to the tank 14, or by flushing with liquid supplied through a pipe 23.

To maintain the required difference of potential between the electrodes 1 and 3, the electrodes 1 may be grounded, and the electrodes 3 connected to wire 24 leading through a rectifier 25 to a step-up transformer 26, which receives alternating current from a suitable supply circuit.

My process is carried out in the above described apparatus as follows: The gas to be treated is led through the flue 12 and header 2 and passes upwardly through the cylindrical electrode members 1. A suitable liquid, for example, water, is supplied through pipes 18 and flowing tangentially from said pipes over the shelves 11, is distributed uniformly over the inner surfaces of the electrode members 1 forming a liquid film electrode surface on each electrode member 1. The discharge electrodes 3 are raised to a suitable potential difference, relatively to the collecting electrodes, by means of the supply connections shown, so as to cause ionization of the gas in the vicinity of electrodes 3 with the result that the particles suspended in the gas adjacent to said electrodes are charged similarly to electrodes 3 by the discharge carried by the ions proceeding from said electrodes. The particles so charged are driven transversely of the current of gas, toward the collecting electrodes, by the action of the electric field between the electrodes, and by reason of the absence of any counter-ionization or counter-discharge at the collecting electrodes, the particles are enabled to reach the collecting electrodes without interference and are completely precipitated on the liquid film surface thereof. The absence of counter-ionization at the electrodes 1 is due largely to the fact that the liquid film, by reason of its surface tension, maintains a smooth, even surface and prevents concentration of the electric field at any point. Moreover, the liquid being continually supplied at the top of the electrodes 1 flows downward in a steady film-stream, which continually car-

thereto to form a liquid film on its inner surface, an insulated support extending over said pipe, a discharge electrode hung from said insulated support and extending axially in said pipe, an insulated retaining means extending below said pipe and engaging said discharge electrode, and means at the lower end of said pipe for catching the liquid descending on said pipe and directing it away from said retaining means.

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ART OF PRODUCING ELECTRICAL PRECIPITATION OF PARTICLES FROM FLUID OR GASEOUS STREAMS.

APPLICATION FILED SEPT. 16, 1915.

1,357,202.

Patented Oct. 26, 1920.

3 SHEETS—SHEET 1.

FIG. 1.

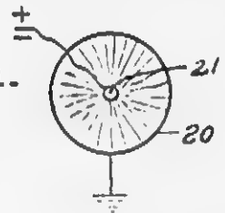


FIG. 2.

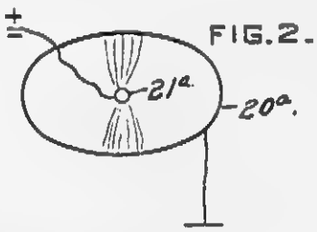


FIG. 4.

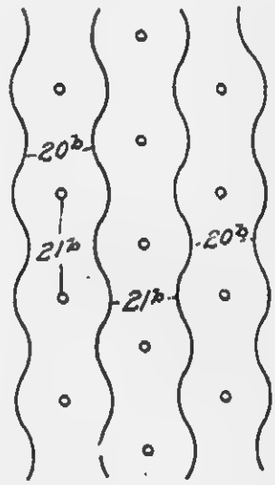


FIG. 3.

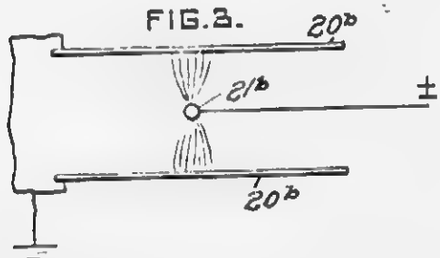


FIG. 5.

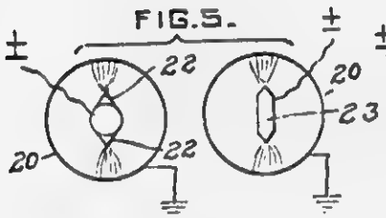


FIG. 6.

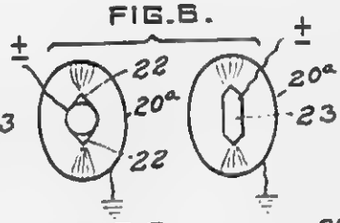


FIG. 7.

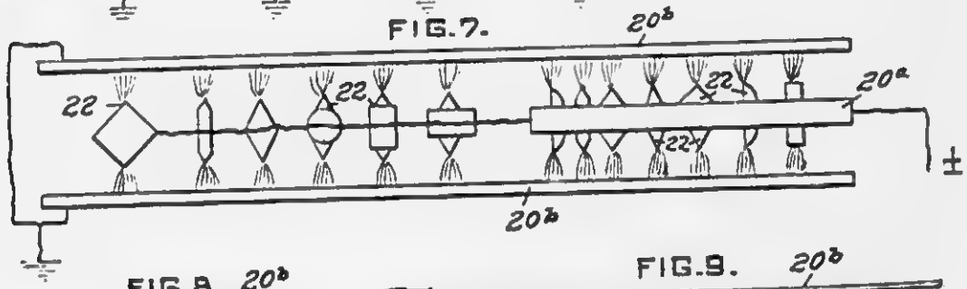


FIG. 8.

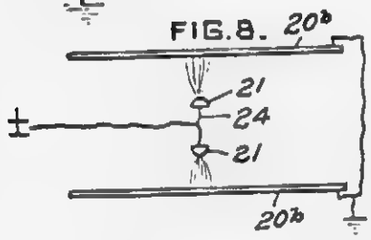


FIG. 9.

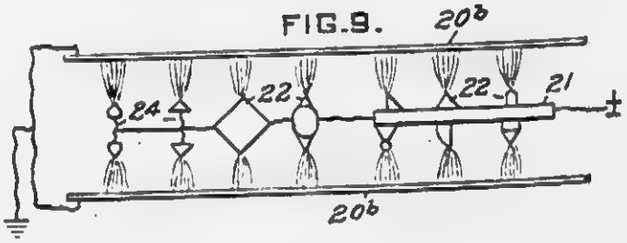


FIG. 10.

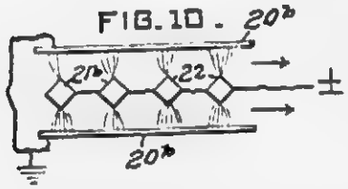
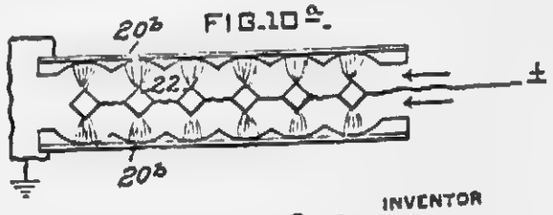


FIG. 10a.



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ART OF PRODUCING ELECTRICAL PRECIPITATION OF PARTICLES FROM FLUID OR GASEOUS STREAMS.

APPLICATION FILED SEPT. 16, 1915.

1,357,202.

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3 SHEETS-SHEET 2

FIG. 11.

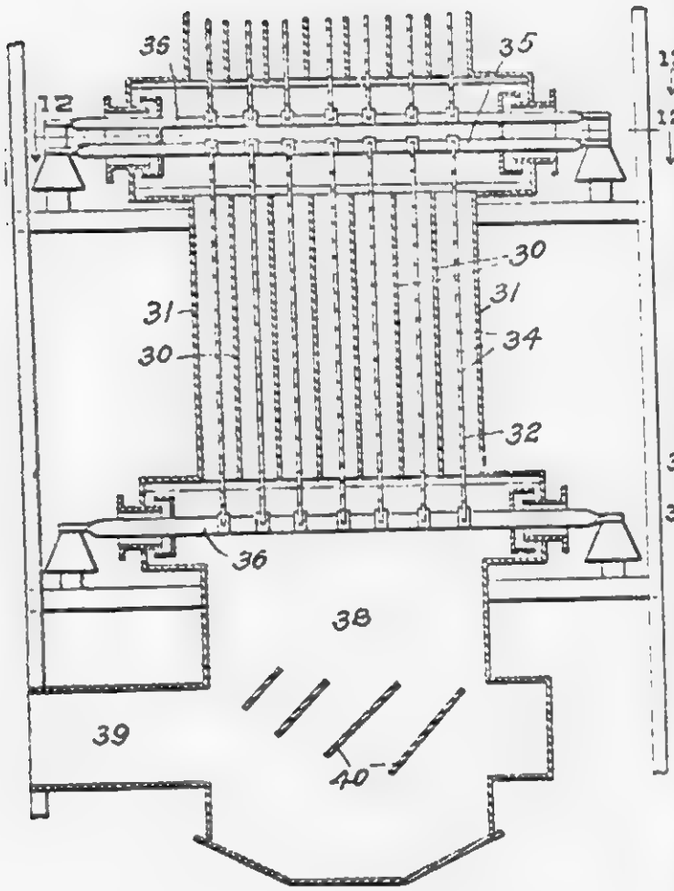


FIG. 12.

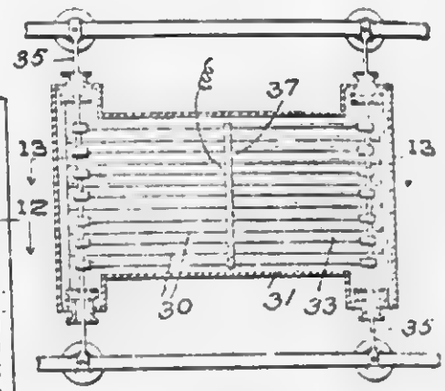


FIG. 13.

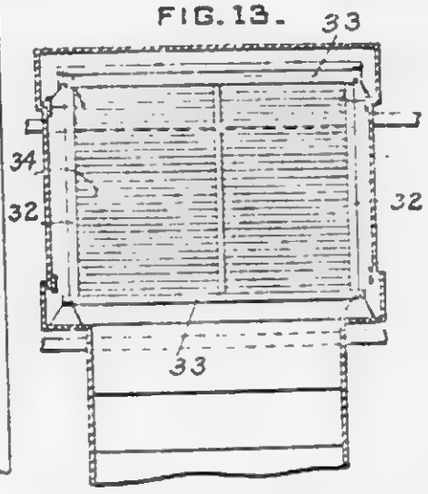
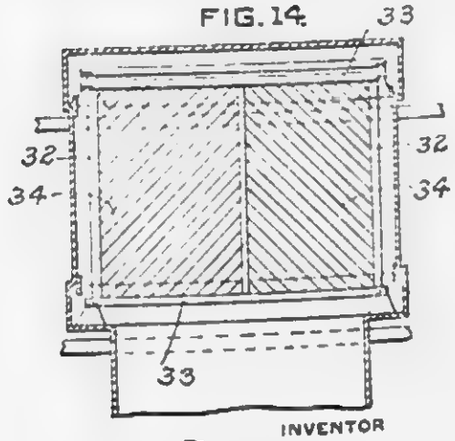


FIG. 14.



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APPLICATION FILED SEPT. 16, 1915.

1,357,202. Patented Oct. 26, 1920.

3 SHEETS—SHEET 3.

FIG. 15.

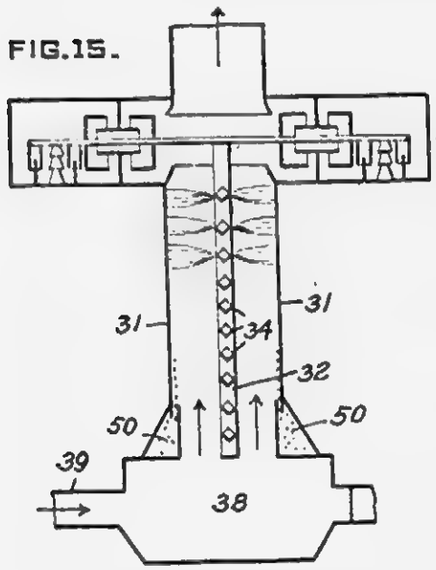


FIG. 17.

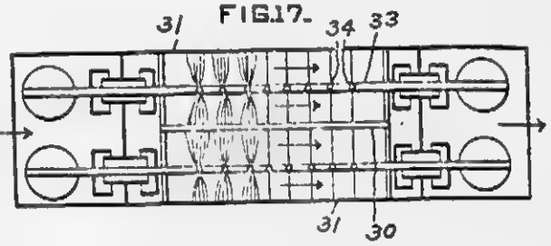


FIG. 18.

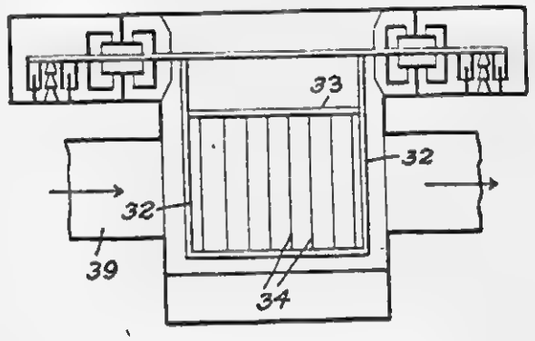


FIG. 18.

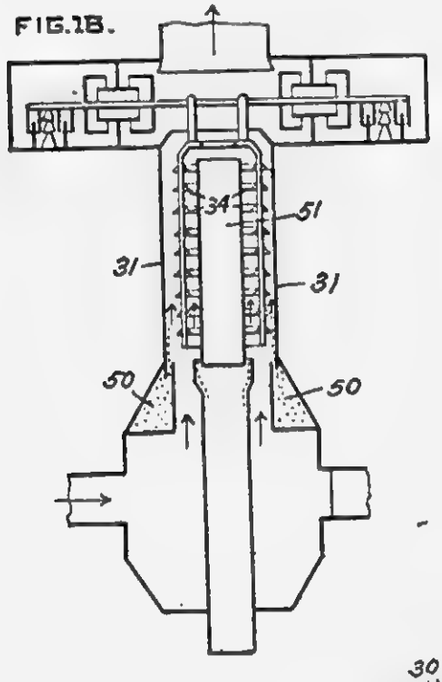


FIG. 19.

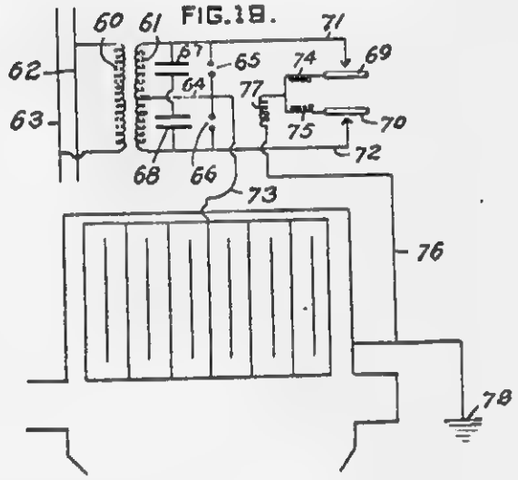
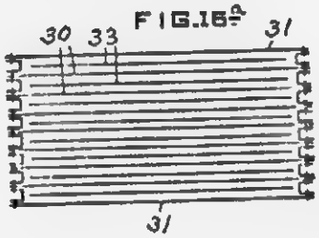


FIG. 16.



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ART OF PRODUCING ELECTRICAL PRECIPITATION OF PARTICLES FROM FLUID OR GASEOUS STREAMS.

1,357,202. Specification of Letters Patent. Patented Oct. 26, 1920.

Application filed September 16, 1915. Serial No. 51,017.

To all whom it may concern:

Be it known that I, ARTHUR F. NESBIT, a citizen of the United States, residing at Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in the Art of Producing Electrical Precipitation of Particles from Fluid or Gaseous Streams, of which the following is a specification.

My invention relates to improvements in the art of separating solid and liquid particles from gaseous and fluid streams by electrical precipitation.

Possibility of precipitating particles from gaseous and fluid streams by the use of electrical discharges is well known, the discharges employed being the brush, point, corona, and other types, the general action being to form an ionization field between electrodes placed in or near the fluid or gaseous medium, the active electrode surface generally being smaller than that of the other electrode, the two electrodes forming what may be termed an asymmetrical pair. In practice, the ions are produced by the action of the discharges emanating from the active electrodes, the luminous, heat and ionizing effects being generally localized and very intense in the neighborhood of these electrodes.

Secondary ionization of the gaseous or fluid medium may also contribute very materially to the breaking down of the insulating difficulties of the medium. This ionization effect may be due to the collisions of the ions with the gaseous or fluid particles and give rise to the production of a large number of positive and negative ions. These ions will be repelled or attracted by the active electrode, dependent upon whether they are of similar or unlike charge, and where this secondary ionization is sufficiently intense and continuous, the flow of ions may be designated as a stream of ions or an electric current.

The removal of suspended particles in gaseous and fluid bodies by the electrical precipitation method involves the action of electric winds, the ionization of the medium, and, to a large extent, the formation of nuclei.

The electromagnetic wave is made up of two components, the electrostatic and the magnetic, the former accounting for the electric currents in the form of electrical discharges, which may be steady, disruptive, alternating, pulsating, or oscillating in character. These waves may be the so-called pure waves, in that their two components, due to the electrostatic field and the magnetic field, are of equal magnitude and constitute the ether-distortion or ether-motion states, both traveling along together and mutually sustaining each other. These electromagnetic waves may be made to travel along between two wires, between two broad sheets of metal, between two outer sheets of metal wholly or partly inclosing another sheet of metal, wire mesh, or a parallel grouping of wires. Between these forms of conducting surfaces, the electromagnetic wave moves along without spreading out by reason of its confinement in much the same manner as a sound wave is confined within a speaking tube through which it passes.

In the present invention, it is the purpose to utilize one or more of the well-known phenomena associated with electromagnetic waves, especially when these waves are so controlled as to give rise to more or less faint nodes and loops on the conductors constituting the electrode system, as well as in the dielectric medium through which the magnetic wave is passing.

Other and more specific objects of the invention are:—

(*a*) To establish, through the medium of an electrode sytem, a precipitating effect which is not only operative within the immediate zone between the electrodes of the system, but is also effective immediately in advance of such system to produce an agitating effect upon the medium being treated and thereby facilitate the precipitating action.

(*b*) To establish individual ionizing zones of definite form and length within the electrode system in such manner as to minimize discharge localization within the individual zones.

(*c*) To establish such individual ionizing zones within the flow path of the medium being treated in such manner that the medium, in traversing the fields provided by the electrode system, moves in directions angular to the directions of length of the zone.

(*d*) To provide an electrode system which is substantially rigid in construction and of

a type in which the ionizing zones are made substantially constant in operation.

(*c*) To provide an electrode system which is operative at high efficiency whether the electromagnetic waves are of high or low frequency as well as of large or small amplitude.

(*f*) To provide an apparatus in which the electromagnetic waves may be controlled so that either their electrostatic or magnetic components may be made the predominating one at will.

(*g*) To provide an apparatus adapted to operate with electric potentials of high or low frequencies, and which will produce electric discharges which may be steady, disruptive, alternating, pulsating, or oscillating in character.

(*h*) To produce an apparatus for this purpose capable of maintaining its working conditions under exacting service conditions, which is of a form and structure not liable to material damage under such conditions, thereby reducing the necessity for repairs and renewals, and which is capable of treating large streams of gaseous or other fluid media.

To these and other ends, the nature of which will be readily understood as the invention is hereinafter disclosed, my invention consists in the improved methods of producing the efficient separation, and the combination and construction of parts hereafter fully described, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims.

In the accompanying drawings, in which similar reference characters indicate similar parts in each of the views,

Figure 1 is a diagrammatic view of a simple form for producing a circular ionizing field.

Fig. 2 is a similar view showing the field arranged to provide ionizing zones, one of the electrodes being elliptical in conformation.

Fig. 3 is a diagrammatic view showing the idea of Fig. 2 applied to an electrode system having parallel walls.

Fig. 4 is a diagrammatic view showing one way in which the ideas of Figs. 2 and 3 may be combined.

Fig. 5 is a diagrammatic view indicating different ways in which the formation of zones may be provided with a circular electrode.

Fig. 6 is a diagrammatic view showing several ways in which the formation of ionizing zones may be provided with an elliptical electrode.

Fig. 7 is a diagrammatic view showing various ways in which ionizing zones may be produced, the view also indicating the manner in which a succession of such zones may be provided.

Fig. 8 is a diagrammatic view indicating one way in which the ionizing zones may be provided by a different form of structure.

Fig. 9 is a view of the top of Fig. 7, also showing various ways in which a succession of zones may be formed.

Fig. 10 is a diagrammatic view indicating the manner in which a succession of zones may be provided by electrodes of similar form.

Fig. 10ª is very similar to Fig. 10 and showing the employment of an outer electrode of slightly different configuration.

Fig. 11 is a sectional view of an apparatus which may be employed in carrying out the general principles of the invention.

Fig. 12 is a sectional view taken on line 12—12 of Fig. 11.

Fig. 13 is a sectional view taken on line 13—13 of Fig. 12.

Fig. 14 is a view similar to Fig. 13 showing a modified form of an electrode system.

Fig. 15 is a diagrammatic view showing another way in which the present invention may be carried out.

Fig. 16 is a diagrammatic view indicating a way in which a plurality of electrode systems may be produced in simple manner.

Fig. 16ª is a diagrammatic sectional view of a modification.

Fig. 17 is a diagrammatic view showing a still further modification, the view being in the nature of a horizontal section.

Fig. 18 is a diagrammatic view of the parts of Fig. 17, the view being in the nature of a vertical section.

Fig. 19 is a diagrammatic view indicating one way in which to produce the required electrical circuits.

The formation of an electrode system having one electrode in the form of a circular member of small diameter such as a wire, with the other electrode in the form of a cylinder arranged concentrical about the wire will, as is well known, provide substantially similar radial electric strain lines within the space surrounding the member, and where there is a sufficient difference in potential between the two electrodes, this surrounding field will form a substantially circular or annular ionization zone, an arrangement of this type being shown in Fig. 1, 20 indicating a grounded electrode and 21 the active electrode. If, however, this true concentric relation between the two electrodes is disturbed, as by a shifting of the position of the inner electrode so as to bring it closer to one side than the other of the outer electrode, there is a radical change in the strain line conditions, due to the variation in length of radial gap between the two electrodes at different portions of the cylinder. Consequently, the uniformity of the circular ionization zone is materially disturbed, the zone increasing in activity as the

radial length of the gap decreases, thereby tending to distort the circular ionization zone and individualize it along predetermined lines. Similarly, if the configuration of the outer electrode be varied so as to vary the radial length of the radial gaps at different points, as for instance, by forming the outer electrode elliptical in cross section, a similar effect will be produced, such arrangement individualizing the ionization zones, as shown for instance in Fig. 2, the electrodes being indicated at 20^a and 21^a respectively.

This result is due to the tendency of the strain lines to concentrate within the portion of the system having the radial gap of least length, this being the path of least resistance through the air or other medium which is between the electrodes. This effect is particularly seen in connection with the operations of electrical precipitating apparatus where the electrode system includes the central electrode and the cylindrical electrode concentric therewith. In such arrangement, any part of the inner electrode, which is generally the active electrode (the outer electrode being generally grounded) which is affected in such manner as to decrease the length of the radial gap at a particular point, causes a much greater strain-line concentration at such point, causing it to appear as a luminous point where the usual arrangement provides simply a corona effect on the electrode, thus tending to form a point discharge action instead of the corona discharge action, the immediate effect being to change the relationship between the point ionization zone and the remainder of the zone between the electrodes. Where a plurality of such points are produced, the general ionization zone becomes formed of a plurality of such comparatively small zones which operate individually with respect to the medium being treated instead of as a continuous ionization zone.

A similar localization of the ionization zone is effected by changing the elliptical configuration of the outer electrode to one which has parallel sides with the inner electrode midway between these sides, the arrangement shown in Fig. 3, the electrodes being indicated at 20^b and 21^b respectively. Where the opposing surfaces of the parallel electrodes are smooth, the ionization zone will be substantially continuous throughout the length of the active electrode. Consequently, a plurality of inner or active electrodes extending in parallelism may be employed, these electrodes being spaced apart a proper distance, this spacing, if desired, being sufficient to retain the individuality of the ionization zones, thus forming a succession of localized zones extending in parallelism between the inner and outer electrodes, this being the arrangement shown in Fig. 4 in which the outer electrodes are shown as in the form of corrugated plates, thus additionally tending to individualize the zones. Obviously, if each zone is of extended length in the direction of length of the inner electrode and the medium to be treated is passed in a direction which intersects the direction of length of the zones, the entire medium stream will be subjected to the discharge action of the entire individual zone length, and, where a plurality of inner electrodes is employed, the stream will be subjected successively to the action of such successive zones as it passes between the opposite walls of the outer electrode while flowing in such direction.

This general arrangement of parallel ionization zones of definite length differs materially from the use of electrodes formed of wire mesh, a use heretofore proposed. This difference is due to the fact that in the wire mesh structure the crossing points of the wires necessarily produce variations in the distance between the inner and outer electrodes and consequently variations in the intensity of the field at such points. Such variations serve to concentrate the strain lines on such points and thus tend to produce the character of a point discharge instead of a discharge which is substantially uniform throughout the length of the zone. Decrease in the size of the mesh does not materially affect this difficulty, since such decrease is in a direction which more closely approaches the surface of a sheet or plane, a structure which is very unsuitable in its action in this type of apparatus owing to the extreme difficulty in producing two planes exactly parallel to each other.

These facts enable me to provide the inner electrode in the form of a frame, thereby permitting the formation of a substantially rigid structure in which the predetermined length of the radial gaps between the inner and outer electrodes may be maintained regardless of any vibratory action on the inner electrode wire produced by the action of the apparatus. An application of this principle is shown in Figs. 11–14, which will be more particularly described hereinafter.

I have found that this concentration of the strain lines can be rendered more effective if the surface of the inner electrode is given a variation in cross sectional contour from the circular wire form, especially if this change results in producing an edge in opposition to the outer electrode, thus maintaining the continuity of the zone in the direction of length of the electrode, but still further concentrating the strain lines by reason of the decrease in width of the active surface on the electrode from that provided by the curved surface of the wire to practically a single line. Since the control of the strength of the field between the

edge and the outer electrode still remains controlled by the length of the radial gap therebetween, the operation above referred to with respect to the rigid structure is applicable for use, regardless of the particular cross section of an individual electrode discharge member. This will be readily understood from Figs. 5 and 6, wherein the edges 22 are shown as formed on opposite sides of a circular wire, or the wire may be flattened to form a bar-like body portion 23 with the edges in proper position, or the electrode may be made angular in cross section to produce the edges 22, various forms of which are indicated in Fig. 7, which figure also indicates the ability to locate a plurality of such edges on a single member, this being possible by reason of the fact that the electrode members have the same sign of charge, and consequently no field is set up between opposing surfaces of such combined or connected members.

Obviously, an arrangement of this type can be rendered more rigid and less liable to damage in operation than where it is necessary to depend upon the tension of the wires to retain the constant length of the gaps between the inner and outer electrode which is desired in order to eliminate as far as possible the localized point discharge due to vibration. In addition, this arrangement tends to decrease the accumulation of deposits on the active electrode on the edge in a manner to vary this radial length of gap, the surfaces leading to the concentrating edge being such as to tend to clear such deposits; this fact combined with the fact that the active part of the edge of the electrode is practically a line instead of a comparatively extended surface of the curved wire, reduces this liability of the deposit accumulating and adhering to the electrode within the zone itself. Should such accumulation occur, it will be more rapidly cleared under a break-down action of the field when the accumulation reaches the stage where a disruptive discharge or arc is formed between the edge and the outer electrode.

As shown in Fig. 8, a somewhat similar effect will be provided by employing a pair of edges spaced apart across the width of the channel between the plates of the outer electrode, these edges being connected by a wire 24 so as to have the same charge sign. Such structure may be employed separately or in combination with other structures, as shown in Fig. 9. However, the fact that the structure of Fig. 8 would leave the space between the connected electrodes practically free from ionizing effects renders the solid structures of Figs. 7 and 9 more desirable in that the latter substantially forces the contents of the medium stream to pass through the ionization zones. Obviously, the outer electrode may have a concave or corrugated surface structure where this type of active electrode is employed, this being indicated in Fig. 10ª.

Various ways may be employed in carrying out the general principles of the invention above indicated with respect to the electrodes of the circular contour type or of the edge or angular type.

In Figs. 4, and 11–14, I have shown several ways in which electrodes of the circular contour type, such as wires, may be employed. In Figs. 11–13, I have shown the wires as extending horizontally in parallelism and in vertical alinement, the arrangement shown illustrating a way in which a plurality of passageways or conduits for the medium to be treated may be provided, each conduit having its independent action. In this construction, the conduits are formed by the use of spaced apart plates 30 extending parallel to the outer walls 31 of the casing, thus causing the plates 30 to each form an electrode common to two conduits, these plates and the casing forming part of what may be termed the grounded electrode system. The inner or active electrode of each conduit is formed of a frame comprising side members 32 and end members 33, these being metallic and of suitable cross section, the individual electrodes being in the form of wires 34 strung between the side members 32, the wires extending horizontally and parallel with each other. This frame extends vertically through the conduit with the wires preferably spaced midway of the distance between the grounded electrodes of the conduit, each conduit having a similar frame, the several frames being supported above and, if desired, also below the conduits by bars 35 and 36 preferably supported externally of the casing, the bars 35 being preferably located in a manner to support the frame at the top of the frame sides.

By this arrangement, each individual active electrode (the frame) is substantially rigid structurally, and, in addition, the several frames are also supported rigidly by the bars 35 and 36, where the latter are employed. Consequently, the entire active electrode system which is thus produced is formed and supported fixedly with respect to the grounded electrode system with which the several electrode frames coöperate.

This rigid form of construction is of especial advantage by reason of the fact that the vibrations set up in the active electrode of previous types of apparatus are substantially eliminated or rendered ineffective. As is well known in connection with apparatus in which the electrode is in the form of a wire or other single member supported at one end, the variations in intensity of the direction of length of the ionization field

due to the accumulation of particles on the electrode tend to produce material vibration to the electrode throughout its discharge length. Where the electrode has its length corresponding to the direction of length of the flow of the gaseous stream, this change in intensity also tends to affect the motion of the stream itself, tending to increase this vibratory effect; unless the grounded electrodes are rigidly secured, there is a tendency to set up physical vibrations in such grounded electrode, apart from the vibration due to tremor of the structure as a whole, the general tendency being to prevent uniformity in the ionization zones, these variations in intensity immediately producing a localizing effect on the zone, the strain lines concentrating at these particular points and thus materially varying the characteristics of the zone in the direction of its length. This necessarily affects the result produced on the gaseous stream, since there is material variation in intensity throughout the zonal length, such variations affecting the ionizing operation. Obviously, where the active electrode is of a type which lends itself to such localizing effect, as where the electrode is free to swing, this condition will rapidly occur and tend to render the apparatus somewhat unstable in operation.

On the contrary, the active electrode formation disclosed herein is such that the opposite ends of the portions of the electrode which produce the discharges are not only individually held against material vibration by the frame in which they are mounted, but, in addition, the fact that these individual discharge elements are each mounted in the same frame, the latter in itself not being intended to produce a material ionizing effect, increases the ability of the active electrode to resist such vibrations as would tend to set up such unstable condition: this is especially true by reason of the fact that the entire individual discharge element would be forced to move bodily in order to produce this result, thus producing a similar condition throughout the length of the zone instead of localizing the effect at one or more points in such zone length.

Where the frames are additionally braced at their lower ends, the additional support provided is such as would prevent bodily movement of the frame itself should extreme conditions arise as would set up vibrations of the frame through the changing of zone intensity produced throughout the length of one or more of the electrodes at the unsupported end of the frame.

The active electrode system is supplied with its current by connecting the electrode frames to a source of high potential, a connection of this type being indicated at 37, (Fig. 12) in the form of a bar. I preferably locate this connection at that portion of the system which is opposite the inlet ends of the conduits. For instance, in the structure shown in Figs. 11–13, I have shown this connection at the top of the active electrode system, the medium to be treated entering the conduits at the bottom, the lower ends of the conduits being in open communication with a chamber 38 into which the medium to be treated is introduced through a passageway 39, the chamber preferably having baffles 40 which tend to direct the medium toward and distribute it among the several conduits, the chamber also forming a collecting chamber for the precipitate.

The active electrode system is properly insulated in suitable manner, thereby providing for proper action between the several electrodes when current is supplied to the active electrode system.

In operation, I prefer to employ a voltage sufficient to produce a corona in connection with the discharge portions of the active electrode system, this being a phenomenon obtainable with this type of apparatus. Obviously, the entire active electrode system has the same sign of charge, and consequently, a proper spacing of the wires relative to each other tends to set up independent ionization zones having their direction of length coresponding to the direction of length of the wire strands, this direction, in the form of apparatus shown, extending horizontally, substantially parallel to the plane of the inlet end of the conduit, successive wires in the direction of flow of the medium forming successive zones through which the medium passes, each zone, under proper working conditions, extending throughout the width of the conduit, so that the medium is subjected successively to the action of these successive zones.

The general ionizing action which is set up in the several zones during the flow of the medium is well known, the dielectric capacity of the medium controlling, to a certain extent, the electromagnetic radiations. Where the active system is arranged along the lines herein indicated, this effect is somewhat increased, due to the tendency to form electric winds or whirls within the conduit, these tending to increase toward the lower ends of the conduits and having their maximum effect at the inlet ends of the conduit, the effect being more apparent within the chamber immediately in advance of the conduit entrance, this phenomenon being more particularly present at the opposite end of the system from that to which the connection with the source of potential is made. In the structure shown, this maximum effect is had within the chamber immediately in advance of the entrance to the conduits, the connection 37 being located at the opposite end of the active electrode system. This effect is very pronounced in the structure

illustrated by reason of the frame-like effect of the lower end of the system, experiments having shown that these whirls are not materially localized, an action which might possibly occur where the electrode is in the form of a wire extending through a pipe with the lower end free from connection with an extended metallic surface. The particular location of this whirl-forming effect may be considered as an agitation field.

In the arrangement shown in these figures, I have shown a plurality of active electrode systems, the supporting bars extending through the walls of the casing and insulated therefrom preferably in a manner which will permit the entrance of external air at suitable points, this air being drawn into the casing by the suction action produced by the travel of the medium through the casing. This is optional, dependent upon the character of work.

As will be seen, this arrangement exposes but a small electrode surface for the collection of particles at points where such collections might materially affect the operation of the apparatus, the bars 35 and 36 being bent so that their flat faces are vertical. Consequently, the liability of accumulative collections of particles on the wires to an extent sufficient to cause the formation of a disruptive discharge or arc between the electrodes is materially reduced, in addition to which the disruptive action produced by the arc formation will tend to more rapidly break down the collection or deposit.

If desired, the wire electrodes may be arranged inclined, as shown in Fig. 14, thus giving an effect somewhat similar to that of the upper end of the fan parallel type of antennæ in the wireless telegraph system, the wires being arranged to extend in opposite directions, as shown, or having all of the wires of the frame extending in the same direction but parallel with each other, the particular construction being dependent upon the particular use and requirements of the installation. The degree of angularity of the wires relative to the direction of flow of the medium may, of course, be varied, but I prefer to provide a variation sufficiently great as to force the medium to pass through successive independent ionization zones as the medium flows through the conduits.

The electrodes of the edge type may be substituted for the wires of the structures shown in Figs. 11–14, but I prefer to employ an arrangement differing somewhat from that construction where the edge form is employed. For instance, in Fig. 15, I have shown a single conduit having the frame built up of electrodes of the edge type, the flow of the medium being indicated by the arrows as upwardly through the conduit. The specific electrodes extend horizontally, forming ionization zones the length of which also is in a horizontal direction. I have also shown pockets 50 in the casing properly positioned to receive that portion of the material which is precipitated by contacting with the plates of the grounded electrode system, the flow path of the medium in this form being vertically through the conduit and thus successively intersecting the ionization zones formed by the grid-like structure of the active electrode system.

In Fig. 16 I have shown the idea adapted to a casing circular in cross section in which the conduit is made annular with respect to an inner member 51, the latter forming part of the grounded electrode system. In this form, the edges may be in the form of rings carried by a suitable support, or may be members mounted on a cylindrical support which extends parallel to the casing walls, the edge member and the cylindrical member forming the equivalent of the frame structure referred to. In this arrangement, provision is additionally made for the removal of the precipitated material which contacts with the walls of member 51. Obviously, this arrangement might be elongated in the direction of zone length to form separate conduits of the general form indicated in Fig. 15, thus providing a pair of conduits; however, I prefer for some purposes to make member 51 in the form of a plate where such elongated structures are mounted, thus enabling a somewhat sectional arrangement to be provided by a built up structure embodying parallel plates spaced apart at their side edges, these edges being joined together by channel members, thereby enabling the formation of a plurality of conduits in a similar manner and permitting the addition of conduits when necessary. A diagrammatic representation of such construction is shown in Fig. 16ª.

As will be obvious, the general principles may be embodied in a construction in which the medium to be treated travels through the apparatus in a horizontal direction, Figs. 17 and 18 diagrammatically indicating an arrangement of this type, the active electrodes having their discharge edges extending vertically, the direction of length of the member supports extending in the direction of length of the conduit, thereby retaining the arrangement by which the material is caused to pass through successive ionization zones in traversing the conduit, pockets being directly underneath.

Where the flow path through the ionization field is in a horizontal direction, I have found it advantageous for certain purposes to form the grounded electrode of a corrugated type, such for instance, as shown in Figs. 4 and 10ª, the concave face of the grounded electrode of a zone acting somewhat in the nature of pockets, those solid or material particles which have, through the

ionizing action, been thrown into contact with the grounded electrode and have, by this action, lost their charge, tend to drop by gravity within these depressions or pockets to the receptacle therebelow, being less liable to be picked up and carried onward by the scouring action of the stream. This form may also tend to carry particles into the more dense portion of the succeeding ionization zone, those particles which may be flowing through the weaker portion of a zone in proximity to the concave surface of the electrode being carried inward by the particular shape of these concave portions and thus placed in a position where the stream will carry them into desired portions of the zone. Obviously, this feature may also be employed in connection with vertically flowing streams, although in such case, the particles would drop through successive zones.

In Figs. 14–16 and 17 and 18, I have shown suitable baffle structures or dust shields, the numeral 60 tending to reduce liability of the dust, etc., passing out of the casing, these structures forming tortuous passageways which must be traversed by the dust in reaching the active electrode system-supporting portion of the casing, thus tending to decrease liability of affecting the insulated condition.

As heretofore pointed out, the invention contemplates the use of electric currents of high potential, although wide variations may be had as to frequency and amplitude of the electromagnetic waves, the apparatus operating with high efficiency with waves of high or low frequency and of large or small amplitude. The invention is also applicable for use with various types of electric current: I prefer, in most cases, however, to employ the unidirectional type, this having been found to be more efficient than the alternating type in this type of apparatus. The form of the unidirectional current may be varied to meet desired conditions. For instance, the source of current may provide an actual or approximate uniformity in the wave line, such as may be provided by batteries or high tension direct current machines, or the current may be intermittent or pulsating in character, or it may be oscillating in character and at the same time unidirectional, these various forms having their individual action on the ionization fields. Obviously, rectified alternating currents of various types may be employed for the purpose.

In the drawing I have shown in Fig. 19 one form in which the desired current may be provided. In this view, 60 and 61 represent respectively the primary and secondary of the transformer, the primary being connected to lines 62 and 63, the secondary 61 having a middle tap 64 connected to the center of a double spark gap 65, 66. The condensers 67 and 68 are connected across the terminals of the secondary. Asymmetrical spark gap rectifiers 69 and 70 are connected by leads 71 and 72 with the secondary 61. The active electrode system is connected to tap 64 through lead 73. The casing and negative electrodes, indicated as the grounded electrode system, are connected through lead 76 with inductances 74 and 75 leading from the spark gap rectifiers 69 and 70, inductance 77 being interposed between the system and inductances 74 and 75, the grounded terminal being indicated at 78. The several inductances serve their usual purpose of sustaining the current as the voltage wave is approaching its neutral or zero position.

While a current forming apparatus such as that just described may, in the absence of the precipitation apparatus cause intense ionic streams across the gaps of the rectifiers 69 and 70, tending to increase the hissing effect and may tend to produce arcs across the gaps, thus requiring adjustment of the gaps, the presence of the active and grounded electrodes system of a precipitation apparatus tends to reduce this necessity, the arrangement tending to maintain a quiet or slightly humming arc.

Obviously, other forms of apparatus may be employed. For instance, such apparatus may have various groupings of resistances, inductances, spherical spark gaps, etc., such combinations being intended as equivalents of the form shown in the drawings.

What I claim is:—

1. Apparatus for electrical precipitation comprising opposing electrode systems, the discharge system comprising a frame carrying rigidly a plurality of electrode elements extending in parallelism with each other and with one side of said frame.

2. Apparatus for electrical precipitation comprising opposing electrode systems, the discharge system comprising a rigid frame carrying rigidly a plurality of electrode elements extending in parallelism with each other and with one side of said frame.

3. Apparatus for electrical precipitation comprising opposing electrode systems, the discharge system comprising a frame carrying rigidly a plurality of electrode elements extending in parallelism with each other and with one side of said frame and transversely to the direction of gas flow.

4. Apparatus for electrical precipitation comprising opposing electrode systems, the discharge system comprising a rigid frame carrying rigidly a plurality of electrode elements extending in parallelism with each other and with one side of said frame and transversely to the direction of gas flow.

5. Apparatus for removing particles from fluid streams comprising opposing electrode

systems having a discharge electrode and collecting electrode, said electrode systems being adapted to form an ionization field for diverting and collecting particles from the stream in proximity to the surface of the collecting electrode, said collecting electrode forming a conduit for the flow of the stream and collected particles through said ionization field, and means in approximate alinement with the electrode structure for isolating the traveling collection of particles and separating them from the stream, said means being located adjacent to one end of said ionization field.

6. Apparatus for removing particles from fluid streams comprising opposing electrode systems, including a collecting electrode structure, said systems being adapted to produce an ionization field for diverting particles from the stream and collecting them in proximity to the surface of the collecting electrode, and an element adjacent to one end of the collecting electrode structure to provide an outlet for collected particles independent of the stream.

7. Apparatus for removing particles from fluid streams comprising opposing electrode systems, including a collecting electrode structure, said systems being adapted to produce an ionization field for diverting particles from the stream and collecting them in proximity to the surface of the collecting electrode, an element adjacent to one end of the collecting electrode structure to provide an outlet for collected particles independent of the stream, and a deposit chamber in communication with said outlet.

8. Apparatus for removing particles from fluid streams comprising opposing electrode systems and having a discharge electrode and a tubular collecting electrode, said electrode systems being adapted to form an ionization field therebetween for diverting and collecting particles in said stream in proximity to the surface of the said collecting electrode, and means located adjacent to one end of said ionization field for trapping and isolating the collected particles from the fluid stream.

9. Apparatus for removing particles from fluid streams comprising opposing electrode systems and having a discharge electrode and a tubular collecting electrode, said electrode systems being adapted to form an ionization field therebetween for diverting and collecting particles in said stream in proximity to said collecting electrode, and means located adjacent to one end of said ionization field for trapping and isolating the collected particles from the fluid stream, said discharge electrode systems being arranged to produce an agitation field within the flow path in advance of the ionization field.

10. An electrical precipitation apparatus comprising concentric collecting electrodes with a discharge electrode system located therebetween, the discharge electrode system comprising a series of edge annular electrodes extending in each direction toward a collecting electrode, and supported on a hollow cylindrical structure.

11. An apparatus as claimed in claim 10 in which there is located adjacent the lower ends of the collecting electrodes, means for trapping and isolating the collected particles from the fluid stream.

12. Apparatus for removing particles from fluid streams comprising opposing electrode systems, including a collecting electrode structure and an edged discharge electrode structure, said systems being adapted to produce an ionization field for diverting particles from the stream and collecting them in proximity to the surface of the collecting electrode and an element adjacent to one end of the collecting electrode structure to provide an outlet for collected particles independent of the stream.

13. Apparatus for removing particles from fluid streams comprising opposing electrode systems, including a collecting electrode structure and an edged discharge electrode structure, said system being adapted to produce an ionization field for diverting particles from the stream and collecting them in proximity to the surface of the collecting electrode and means located adjacent to one end of said ionization field for trapping and isolating the collected particles from the fluid stream.

14. In the art of producing electrical precipitation of particles from fluid or gaseous streams, opposing electrode systems including a collecting electrode structure, said systems being adapted to produce an ionization field for diverting particles from the stream and collecting them in proximity to the surface of the collecting electrode, means for conducting the stream to said electrode systems, and means for separately collecting the cleaned stream of gases and the separated particles.

In testimony whereof I affix my signature in presence of two witnesses.

ARTHUR F. NESBIT.

Witnesses:
MARY MCLAUGHLIN,
W. G. DOOLITTLE.

Aug. 31, 1948. G. W. PENNEY ET AL 2,448,046

PRECIPITATOR

Filed July 6, 1945 2 Sheets-Sheet 1

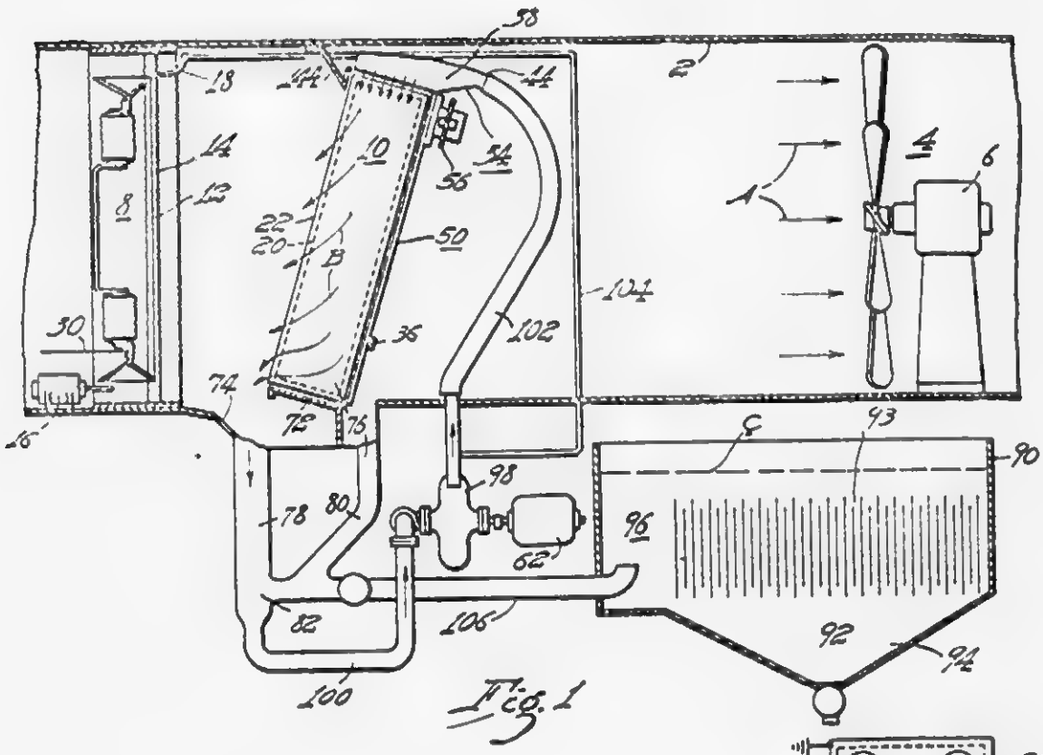

Fig. 1

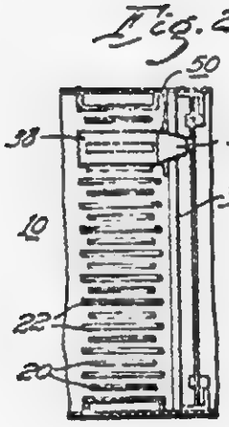

Fig. 2.

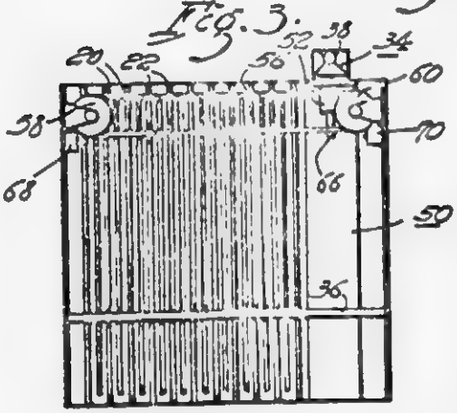

Fig. 3.

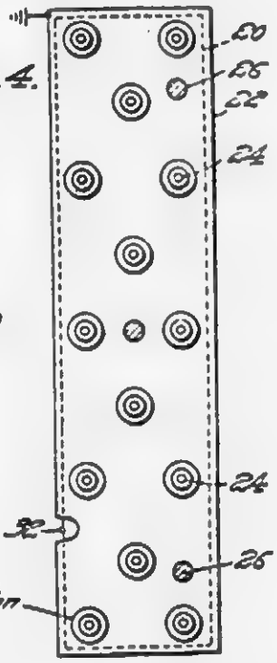

Fig. 4.

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Filed July 6, 1945 2 Sheets-Sheet 2

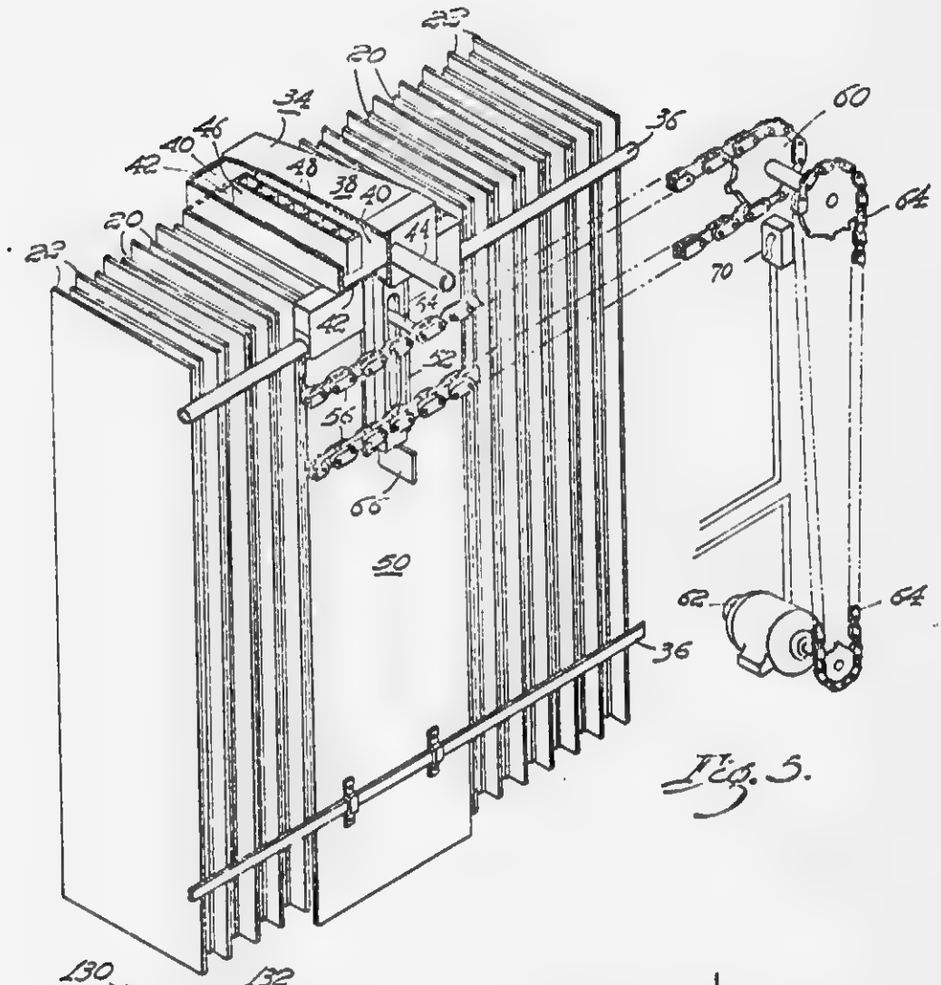

Fig. 5.

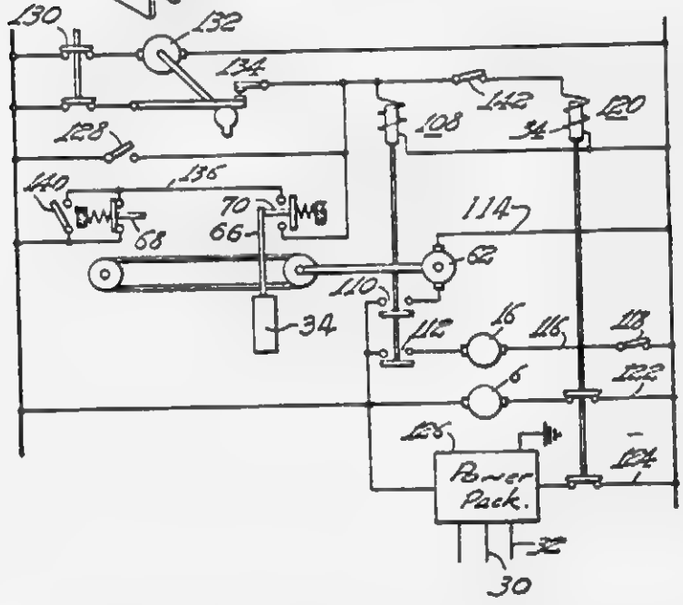

Fig. 6.

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Application July 6, 1945, Serial No. 603,503

20 Claims. (Cl. 183—7)

1

This invention relates to electrostatic dust-precipitators for the efficient cleaning of a gas, particularly air flowing at relatively high velocities. This invention also relates to a pumping system useful for keeping the dust-collecting electrodes of electrostatic dust-precipitators clean.

It is among the objects of our invention to provide an electrostatic dust-precipitator of high capacity for its size so that it may be effectively used in places where the space available for receiving the dust-precipitator is limited or accessible with difficulty.

It is a further object of our invention to provide an electrostatic dust-precipitator system of a type having separate dust-charging means and dust-precipitating means, each comprising a plurality of electrodes, and means for periodically cleaning electrodes with clean liquid each time.

An additional object of our invention is to provide an electrostatic dust-precipitator of the aforesaid type, having novel self-contained cleaning means for removing dirt collected on its dust-collecting electrodes, which means can be operated either while gas is flowing through the dust-precipitator for cleaning, or while the gas flow is stopped and the electrical energization of the dust-precipitator interrupted.

The invention described herein is based upon, and in a sense constitutes a continuation-in-part and improvement upon the invention disclosed and claimed in our co-pending application Serial No. 544,581, filed July 12, 1944. In the latter application, we disclose a system comprising an electrical dust-precipitator having dust-collecting electrodes which constitute part of a predetermined loop-circuit in which a liquid is circulated for removing precipitated dust from the dust-collecting electrodes, and leaving a fresh layer of cleaner liquid on their surfaces for improving the retention of subsequently precipitated dust. An important feature resides in providing a combined structure which permits the use of the same liquid over and over for cleaning the dust-collecting electrodes, the liquid being stored in a reservoir or tank from which a suitable quantity is withdrawn for use in the loop-circuit and returned after use. During use for cleaning the dust-collecting electrodes, the liquid circulates around and around in the loop-circuit.

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The liquid itself is cleaned in the intervals between the periods in which it circulates in the loop-circuit, the cleaning of the liquid being done by electrostatic means because we have found that such means quickly and effectively cleans a liquid containing dirt such as is electrostatically precipitated from air. The liquid-cleaning electrostatic means is associated with the tank in such manner that a sludge is formed which falls into a separate portion of the tank. A further feature of the invention described in our copending application resides in providing an arrangement for preventing sludge from mixing back into the cleaned liquid when the latter is withdrawn for cleaning the dust-collecting electrodes or when dirty liquid is returned to the tank after use.

An important object of the present invention is to provide a system of the aforesaid type in which a liquid withdrawn from the tank can be circulated in a loop-circuit that does not include any part of the tank. However, an open pipe connection is provided between the tank and loop-circuit through which liquid for circulation can at any time be withdrawn from the tank by the starting of a pump, and returned to the tank when the pump is stopped. By segregating the loop-circuit entirely from the tank, the liquid that travels around the loop-circuit is much less likely to disturb sludge in the tank or other liquid in the tank undergoing cleaning at the same time of having concentrated dirt in it. This means that the speed and volume at which the liquid circulates in the loop-circuit can be materially increased, other conditions being the same.

A further object of our invention is to progressively clean an assembly of dust-collecting electrodes in a special manner. Only an increment of the assembly is cleaned at a time, the volume of the cleaning liquid being sufficient to substantially fill this increment with liquid flowing sufficiently strongly to forcefully flush collected dirt from the surfaces of the dust-collecting electrodes being cleaned. The cleaning liquid may be, of course, any suitable substance, of which a number are known. If desired, the liquid may be one for coating the surfaces of the dust-collecting electrodes, and one which flushes off easily.

Many objects, features, combinations, and in-

novations of our invention in addition to the foregoing and those described in our aforesaid copending application, will be discernible or obtainable from the following description and accompanying drawings, in which:

Figure 1 is a schematic vertical view, partly in section, illustrating the principal features of our invention;

Fig. 2 is a schematic plan view of an assembly of a plurality of dust-collecting electrodes, provided with a means movable across the top of the assembly, in a direction transverse to the gas flow, for cleaning them;

Fig. 3 is a schematic elevational view of the apparatus of Fig. 2, looking upstream;

Fig. 4 is a broadside sectional view for illustrating an assembly of a plurality of relatively alternately insulated and uninsulated plate-electrodes;

Fig. 5 is a perspective view of a group of spaced dust-collecting plate-electrodes having plate-cleaning means associated therewith, the latter being shown in greater detail than is shown in Figs. 2 and 3; and

Fig. 6 is a simplified electrical wiring diagram of an operating and controlling apparatus embodied in our invention.

Referring more particularly to Fig. 1, a gas duct 2 is shown in which a gas flow is established in the direction of the arrows A by a blower means 4 which includes an electric motor 6. A gas-cleaning electrostatic dust-precipitator is arranged in the gas duct 2 and comprises an up-stream ionizing or dust-charging means 8 in which gas-borne dust particles receive an electrical charge, and a down-stream dust-precipitating means 10 in which charged dust particles are removed from the gas stream.

The ionizing means 8 includes a plurality of relatively insulated electrodes spaced laterally across the gas duct, and comprising insulated relatively fine ionizing wires 12 and relatively large round-rod uninsulated electrodes 14. The electrodes 14 are periodically rotated by an electric motor 16. Jets 18 supply a cleaning liquid to each electrode 14 when it is rotated. Dust-charging apparatus of this kind is described and claimed in our copending application, Serial No. 784,330, filed November 6, 1947.

The dust-precipitating means 10 comprises an assembly of a plurality of upstanding relatively insulated and uninsulated plates 20 and 22, respectively, held spaced by a plurality of individual small insulators 24, as shown in Penney Patent 2,347,709, dated May 2, 1944. An insulated plate-electrode 20 is between each pair of consecutive uninsulated plate-electrodes 22, with its edges within the rectangular contour of the uninsulated plate-electrodes. The assembly includes a plurality of spaced elongated clamping rods 26 passing through the plates, oversized holes being provided in the insulated plates for added insulation protection. However, any suitable plate-assembly with an open top into which cleaning liquid can be directed, can be used. The rectangular plate-assembly extends across the gas-stream path in the gas duct 2 and is supported with its upstanding edges tilted with the top further downstream than the bottom.

Insulated conductors 30 and 32 convey high potential to the ionizing wires 12 and to the insulated plate-electrodes 20, respectively.

A plate-cleaning means, indicated in its entirety by the reference numeral 34, is arranged

to travel across the top and an upstanding down-stream side of the plate-assembly of the dust-precipitating means, being guided and supported on upper and lower transverse rods 36. As shown more clearly in Fig. 5, the plate-cleaning means 34 comprises a nozzle-device 38 having a chamber 40 with a bottom wall 42. The chamber receives liquid through an inlet pipe 44, and the liquid flows out of the chamber through a rectangular discharge-mouth 46 having a plurality of spaced partitions 48 for directing the liquid flowing out of the chamber. The discharge-mouth 46 is about as long as the width of the plate assembly, and its open width spans one, or at most a few, of the spaces between the plate electrodes 20 and 22; the number spanned being a very minor part of the total number of such spaces provided transversely across the gas duct 2 by the dust-precipitating means 10. The bottom wall 42 spans several more spaces than does the discharge-mouth. The plate-cleaning means 34 also comprises an upright baffle plate 50 which is about the height of the plate-assembly and extends laterally beyond both sides of the bottom wall 42. The insulated plates 20 are sufficiently inside the edges of the plates 22 to provide adequate air-insulation between the high voltage plates 20 and the grounded plate-cleaning means as the last moves past them, as close to the edges of the plates 22 as mechanical considerations permit.

The plate-cleaning means 34 is moved across the dust-precipitating means by any suitable mechanism. That shown comprises an apertured block 52, secured to the plate-cleaning means, preferably to the baffle plate 50. The apertured block 52 has an upstanding elongated slot which receives a pin 54 extending from an endless sprocket chain 56 that engages a pair of sprocket wheels 58 and 60 at opposite sides of the gas duct 2. The sprocket wheel 60 is driven by an electric motor 62 through gearing 64. When the sprocket chain 56 is moving, the pin 54 forces the plate-cleaning means 34 in one direction when the pin is in the upper horizontal stretch or portion of the sprocket chain, and in the reverse direction when it is in the lower stretch.

The apertured block 52 carries a depending lug 66 which operates limit switches 68 and 70 at the ends of the path or stroke in which the plate-cleaning means 34 travels; these limit switches being normally biased to circuit closing position, and operated to circuit opening position when engaged by the lug 66.

It is intended that the amount of cleaning liquid discharged from the nozzle-device be sufficient to fill several of the spaces between the plate-electrodes 20 and 22, and that the liquid flow toward the upstream side of the plate-assembly as well as downwardly. To this end a lower closure plate 72 (Fig. 1) is provided which extends across the gas duct 2 and cooperates with the baffle plate 50 and the nozzle-device 38 to substantially enclose the associated spaces on three sides, thereby forcing liquid discharged at a suitable rate to fill these spaces and to flow forwardly, as indicated generally by the arrows B. Liquid-receiving means or troughs are provided across the gas duct to receive the liquid passing from the dust-precipitating means. A trough 74 below the front or upstream edge of the dust-collecting plate-electrodes receives most of the liquid. A small portion of the liquid is permitted to flow into a back trough 76, the

amount being controlled by the clearance between the bottom edge of the baffle plate 50 and the proximate horizontal edge of the transverse closure plate 72. The troughs 74 and 76 slope downwardly to drain pipes 78 and 80, respectively, which meet at a junction 82 where the different portions of the liquid recombine after having cleaned the plate electrodes.

Liquid for cleaning the plate-electrodes is held in a reservoir or tank 90 from which liquid is withdrawn when the plate-cleaning means is in operation and to which liquid returns when the plate-cleaning means is not in operation. Inasmuch as the liquid becomes contaminated with dirt after passing through the plate-assembly, the tank 90 is provided with an open electrostatic liquid cleaner 92. The cleaner 92 comprises a plurality of alternately relatively insulated and uninsulated plates 93 which extend below the level of the liquid in the tank. When a unidirectional electrostatic field is established between the plates 93, dirt in the liquid concentrates in the liquid at and between the plates, so as to form a sludge that drops into a sludge-receiving portion 94 of the tank. A unidirectional electrostatic field causes quiet liquid in the tank to substantially imperceptibly drift to, into and from the spaces between the plates 93 of the cleaner 92, and soon cleaned liquid is found in a portion 95 of the tank. Additional details of a tank including a cleaner along the lines herein described may be found in our aforesaid application, Serial No. 544,581.

For withdrawing liquid from the tank and using the liquid for cleaning dust-collecting electrodes, a pumping system is provided which comprises a loop or loop-circuit external to the tank 90 and a piping means interconnecting a lower portion of the loop-circuit with a lower portion of the tank 90, preferably its cleaned oil portion 96. The loop or loop-circuit consists of the troughs 74 and 76 and pipes 78 and 80 in parallel, the junction 82, a pipe 100 from the junction 82 to the inlet end of a pump 98, the pump 98, a loose flexible hosing 102 from the discharge end of the pump to the inlet pipe 44 of the nozzle-device 38, nozzle-device 38, and the dust-collecting plate-electrodes of the dust-precipitating means 10. While the loop-circuit can be considered to include all of the dust-collecting plate-electrodes, it should be noted that cleaning liquid flows only through a very small part of the spaces provided by them at any single instant. There is enough play in the hosing 102 to follow the movement of the nozzle-device across the top of the dust-collecting plate-electrodes of the dust-precipitating means 10.

A small branch 104 takes some liquid from the described loop-circuit and delivers it to the jets 18, return liquid flowing into the trough 74.

An open pipe 106 is provided for the free exchange of liquid between the loop-circuit and the tank 90, this pipe 106 having an open end in the lower part of the cleaned oil portion 96 of the tank and another end at the junction 82 at the bottom of the loop-circuit. The loop-path is for the most part above the level of the liquid in the tank 90 which should be of sufficient size to receive all the liquid of the system except for the small portion that might be contained in the various pipes below the liquid level in the tank. The pump 98 has its intake below the normal level of liquid in the tank, which is roughly indicated at C, by normal level meaning the liquid level when the pump is not operating.

Plate cleaning may be carried out for considerably different lengths of time. For example, the nozzle-device 38 may be made to make a slow traverse of the plate-assembly and then stop for an extended period, or it may move completely across the plate-assembly and back, as often as desired. Still another method of operation would be to permit the nozzle-device to move indefinitely back and forth across the gas duct, being stopped only long enough to permit liquid to be cleaned. If clean liquid is continuously supplied to the nozzle-device, it can be permitted to move continuously.

Fig. 6 shows a flexible control system which permits various sequences of plate-cleaning operations. When normally deenergized relay 108 is energized, the front contacts 110 and 112 close, these contacts being, respectively, in circuits 114 and 116 for the motors 62 and 16, respectively. The motor 62 drives the plate-cleaning means 34, and, in the preferred embodiment, also operates the pump 98, through any suitable gearing, if necessary. The motor 16 rotates the uninsulated electrodes 14 of the ionizing means 8. When the contacts 110 and 112 are in open or back position, which is the case when the relay 108 is deenergized, the motors 62 and 16 do not operate. It is also possible to prevent operation of the motor 16 when the contacts 112 are closed by opening a manually-operable normally-closed switch 118 in the circuit 116.

A normally deenergized relay 120 has back contacts closing energizing circuits 122 and 124, respectively, for the blower motor 6 and a high voltage direct-current supply, such as power pack 126. The former creates a gas flow in the gas duct 2, and the latter supplies various direct-current high voltages to the insulated electrodes of the system.

With a control system in the condition shown in Fig. 6, both relays 108 and 120 are deenergized, and the equipment of Fig. 1 would be operating to clean the gas stream in the gas duct 2 and the liquid in the tank 90. The electrodes 14, the pump 98, and the plate-cleaning means 34 would be stationary.

If it is desired to manually operate the plate-cleaning means with the gas-cleaning means stopped, a normally-open manually-operable switch 128 may be closed, thereby causing both relays 118 and 120 to be energized. Upon reopening the switch 128, after any desired time, the gas-flowing gas-cleaning operation is restored. As an added safety measure, a normally closed switch 130 may be provided interlocked with the switch 128, so as to be closed when the latter is open, and vice versa.

If it is desired to automatically periodically operate the plate-cleaning means with gas flow shut down and the power pack 126 deenergized, the switch 128 should remain open and the switch 130 closed so that a timer 132 will be energized. The timer may operate for closing a timer switch 134 once every few hours, say, for example, every ten or twenty hours. It remains closed until lug 66 leaves a limit switch and permits the latter to close.

The relays 108 and 120 will be energized while the timer switch 134 is closed, thereby deenergizing the motor 6 and the power pack 126, and energizing the motors 16 and 62. Assume that the nozzle-device was at the extreme right where it operated to open limit switch 70. Rotation of the motor 62 moves the plate-cleaning means 34 and its nozzle-device 38 toward the left, so that the limit switch 70 closes, establishing a new

energizing, or holding, circuit 136 for the relays 108 and 120, the last circuit including the limit switches 68 and 70 in series. Consequently, although the timer switch 134 reopens, the relays 108 and 120 will remain energized through the circuit 136 until the plate-cleaning means 34 reaches its extreme left-hand position, at which its lug 66 operates to open the limit switch 68, interrupting the holding circuit 136 to the relays 108 and 120. Deenergization of these relays re-establishes gas flow and stops electrode cleaning. When the timer switch 134 closes again, the relays 108 and 120 are reenergized, and the motor 62 starts to move the plate-cleaning means to the right, permitting the limit switch 68 to close and thus re-establish the secondary holding circuit 136 for the relays until the plate-cleaning means has moved to its right-hand position where it again opens the limit switch 70. By closing a normally-open manually-operable switch 140, the plate-cleaning means will make one complete back and forth traverse of the dust-collecting electrodes every time the timer switch 34 operates.

If the cleaning of the dust-collecting electrodes is to be accomplished without interrupting the cleaning of the flowing gas, normally-closed manually-operable switch 142 may be opened for preventing energization of the relay 120 and consequent interruption of the circuits 122 and 124 for the blower motor 6 and the power pack 126, respectively. This is the manner in which we prefer to operate the apparatus.

We consider the operation of the pumping system in connection with electrostatic dust-precipitators an important feature. Referring to Fig. 1, when the pump 98 first starts to operate, cleaned liquid in the tank 90 is drawn into the pipe 106 and passes through this pipe into the lower part of the previously described loop-circuit; more specifically, into the pipe 100 and to the intake of the pump 98. The pump forces the liquid through the hosing 102 into the nozzle-device 38 where the liquid is discharged into the plate-assembly but only into the spaces of the dust-collecting electrodes with which the discharge-mouth 46 of the nozzle-device is associated. Three sides of these spaces are blocked off by the bottom wall 42 of the nozzle-device, the baffle plate 50, and the closure plate 72. The capacity of the pump is sufficient to force the liquid through the few spaces under the discharge-mouth with considerable force, and the barrier means around the three sides of the spaces causes them to be filled with this forcibly flowing liquid. By arranging the baffle plate 50 along the downstream side, the cleansing liquid flows forwardly, except for the small amount that is permitted to pass into the trough 76. After washing the surfaces of the dust-collecting plates, the liquid flows into the troughs 74 and 76 and through drain pipes 78 and 80 to the junction 82 from where it flows again into the pipe 100 leading to the intake of the pump 98. The pump will draw liquid from the tank until the amount of liquid flowing back through the drain pipes is substantially equal to the pump's intake capacity. After this, the liquid recirculates around the loop-circuit over and over without visibly disturbing the liquid in the tank. When the pump 98 stops, liquid drains out of the upper portion of the loop-circuit, flowing back into the tank through the pipe 106 and raising the level of the liquid therein.

The pipe 106 can be restricted sufficiently, or an artificial restriction provided, so that liquid withdrawn or returned to the tank passes through it at a rate which does not significantly disturb the quiescence of the sludge in the tank. Preferably, however, the rate during withdrawal should be sufficiently adequate to prevent objectionable lowering of the liquid head in the pipes 78 and 80. The head of the liquid in the tank should be sufficiently above the lowest allowable level in the pipes 78 and 80 to supply the friction head or drop in the pipe 106 from the tank to the junction 82. This condition also prevents the pump from sucking air. When the pump is operating, the head of liquid in the pipes 78 and 80 will rise above the level in the tank to an extent depending on the friction drop in these pipes. The pipes 78 and 80 should, therefore, be comparatively large in order to prevent the liquid from overflowing the troughs. Preferably, the friction drop should be limited, but the bottom part of the loop-circuit need not hold much liquid when the liquid is not being recirculated.

Several distinct advantages are obtained by limiting the number of dust-collecting electrode surfaces to be cleaned at the same time and by filling the spaces therebetween with forcibly flowing liquid that flows forwardly or upstream. One advantage is that most of the dirt electrostatically removed from the gas stream usually precipitates in the front part of the dust-precipitating means, so that the forwardly moving liquid does not have to carry this heavy dirt deposit through the entire width of the plate-assembly. A second advantage arises from the fact that lint is usually caught on the front edges of the dust-collecting electrodes and will be washed outwardly, minimizing any chances of these long pieces of dust-particles bridging oppositely charged dust-collecting electrodes.

In a practical apparatus, to which our invention is, however, not limited, satisfactory operation was obtained with a nozzle-device having a discharge-mouth extending for substantially the full width of the insulated plate electrodes, but not quite to the upstream edge, and having an open width slightly less than the distance between two consecutive uninsulated electrodes 22. These uninsulated electrodes were about 28 inches high and about 6½ inches wide. The spacing between facing relatively insulated electrodes was .145 inch, with the total number of spaces being well over a hundred. The plate-cleaning means travelled across the plate-assembly at a rate of nearly one-half inch per minute, while cleaning liquid flowed out of the nozzle-device at a rate of close to nine gallons per minute and at a velocity of about 200 feet per minute. Near the top of the plate-assembly, the liquid has an average velocity of about 50 feet per minute downward. Further down in the plate-assembly, the downward component of velocity decreases and the forward component increases, but not to the same degree because of liquid flowing out of the plate-assembly. By slowing down the rate at which the plate-cleaning means travels, the quantity of liquid flowing across the surfaces of the dust-collecting electrodes may be further increased.

Where it is desired to permit gas flow while the dust-collecting electrodes are being cleaned, so as not to interrupt the clean air-supply, the bottom wall 42 of the nozzle-device 38 and the baffle plate 50 should be wider than the discharge-mouth 46 so as to allow liquid to drain from the spaces which the discharge-mouth has just passed or uncovered, while gas flow therethrough is barred, the gas being diverted into other spaces. The slow travel of the plate-cleaning means

allows for a suitable time of drainage, but obviously the width of the bottom wall 42 and the baffle plate 50 may be made to correspond to the rate of travel of the plate-cleaning means.

Because the edges of the baffle plate and nozzle-device extend laterally beyond the discharge-mouth, the gas duct can be provided with closed sections at each lateral end of the dust-precipitating means and suitable baffles such as the baffle 144 in order to divert the gas flow from spaces not provided with dust-collecting electrodes which can be washed.

While we have described our invention in a form at present preferred, other forms are also useful and possible. Our invention is subject to wide modification and many equivalent elements may be substituted therein, or otherwise used, based upon the teachings of our invention.

We claim as our invention:

1. A system of a type described, comprising an electrostatic dust-precipitator for cleaning a gas flow, comprising gas purifying means comprising a plurality of spaced dust-collecting electrodes; a loop-circuit including therein: a pump, said dust-collecting electrodes, a nozzle-device connected to the discharge end of said pump and movable across said dust-collecting electrodes, a trough means extending below said dust-collecting electrodes, and a piping means between said trough means and the inlet of said pump; distinct container means outside of said loop-circuit for cleaning and holding cleaned liquid for circulation in said loop-circuit, said loop-circuit extending above said liquid-holding means; a piping connection between said container means and said loop-circuit; and operable for operating said pump during spaced periods and for moving said nozzle-device progressively across said dust-collecting electrodes; said piping connection being open during pump-operating periods and between such periods.

2. The invention of claim 1 characterized by said nozzle-device comprising a discharge-mouth spanning only a very minor part of the spaces between said plurality of dust-collecting electrodes, and means for restricting the outflow of liquid from said spaces as they are progressively spanned by said discharge-mouth, whereby the spanned spaces become filled with flowing liquid.

3. The invention of claim 1 characterized by said nozzle-device comprising a discharge-mouth spanning only a very minor part of the spaces between said plurality of dust-collecting electrodes, means for restricting the outflow of liquid from said spaces as they are progressively spanned by said discharge-mouth, whereby the spanned spaces become filled with flowing liquid, and means for barring gas-flow through the spaces which are spanned and which have been just uncovered by said discharge-mouth, whereby to permit liquid drainage from said uncovered spaces.

4. A system of a type described comprising a plurality of spaced upstanding dust-collecting plate-electrodes through the spaces of which a gas can flow, a nozzle-device having a discharge-mouth spanning only a minor part of the spaces between said plurality of dust-collecting electrodes, moving means for slowly and progressively moving said nozzle-device across the top edges of said plate-electrodes, a baffle plate associated with said nozzle-device for barring fluid flow through an upstanding side of the spaces spanned by said discharge-mouth, and permitting gas-flow through the other spaces, means for limiting fluid flow through the bottom of said spaces, trough means for catching liquid flowing out from said spaces, a pump having an inlet connected to said trough means and an outlet connected to said nozzle-device, a liquid reservoir extending below said dust-collecting electrodes, and a piping connection between said reservoir and the pump inlet.

5. A system of a type described comprising a plurality of spaced upstanding dust-collecting plate-electrodes through the spaces of which a gas can flow, a nozzle-device having a discharge-mouth spanning only a minor part of the spaces between said plurality of dust-collecting electrodes, moving means for slowly and progressively moving said nozzle-device across the top edges of said plate-electrodes, a baffle plate associated with said nozzle-device for barring fluid flow through an upstanding downstream side of the spaces spanned by said discharge-mouth and permitting gas-flow through other spaces, means for limiting fluid flow through the bottom of said spaces, a trough means for catching liquid flowing out from said spaces, a pump having an outlet connected to said nozzle-device, said moving means being adapted to move said nozzle-device sufficiently slowly for said pump to keep the spaces spanned by said discharge-mouth substantially full of flowing liquid, at least some of which flows with an upstream direction-component.

6. A system of a type described comprising a plurality of spaced upstanding dust-collecting plate-electrodes through the spaces of which a gas can flow, a nozzle-device having a discharge-mouth spanning only a minor part of the spaces between said plurality of dust-collecting electrodes, moving means for slowly and progressively moving said nozzle-device across the top edges of said plate-electrodes, a baffle plate associated with said nozzle-device for barring fluid flow through an upstanding downstream side of the spaces spanned by said discharge-mouth and permitting gas-flow through other spaces, said baffle plate being wider than said discharge-mouth for barring fluid flow through spaces on both sides of said discharge-mouth, means for limiting fluid flow through the bottom of said spaces, a trough means for catching liquid flowing out from said spaces, a pump having an outlet connected to said nozzle-device, said moving means being adapted to move said nozzle-device sufficiently slowly for said pump to keep the spaces spanned by said discharge-mouth substantially full of flowing liquid, at least some of which flows with an upstream direction-component.

7. The invention of claim 5 characterized by said pump having an inlet connected to said trough means, a liquid tank below said dust-collecting electrodes, having electrostatic oil-cleaning means and a sludge portion therebelow, and a connection between said pump inlet and a lower part of said tank.

8. The invention of claim 6 characterized by said pump having an inlet connected to said trough means, a liquid tank below said dust-collecting electrodes, having electrostatic oil-cleaning means and a sludge portion therebelow, and a connection between said pump inlet and a lower part of said tank.

9. A dust-precipitating means comprising a plurality of spaced upstanding alternately relatively insulated and uninsulated plate-electrodes, providing a comparatively large number of

spaces for a gas-flow, plate-cleaning means comprising a barrier-means and a nozzle-device for directing a liquid flow into a very minor number of the total number of said spaces, said barrier means comprising a baffle plate along an upstanding side of said dust-precipitating means, and means operable for slowly and progressively moving said nozzle-device and said baffle plate across said plurality of dust-collecting electrodes, in proximity to the edges of the uninsulated plate-electrodes.

10. The invention of claim 9 characterized by said nozzle-device comprising a discharge-mouth, said baffle plate spanning a greater number of said spaces than said discharge-mouth.

11. A dust-precipitating means comprising an assembly of spaced upstanding dust-collecting plate-electrodes through the spaces of which a gas can flow, said assembly having a tilted downstream side, with its top further downstream than its bottom, and plate-cleaning means comprising a nozzle-device movable along the top edge of said assembly, for directing a fluid flow into a very minor part only of the spaces between said dust-collecting plate-electrodes, barrier means comprising a baffle plate along said tilted side for restricting fluid flow out of spaces receiving fluid from said nozzle-device, and means for moving said nozzle-device across the top edge of said assembly.

12. The invention of claim 11 characterized by said nozzle-device comprising a discharge-mouth which is elongated in the direction of gas-flow and said nozzle device and said baffle plate being wider than said discharge-mouth, and movable with it.

13. A dust-precipitator means comprising an assembly of spaced upstanding dust-collecting plate-electrodes providing spaces through which a gas can flow, said assembly having a tilted upstanding side, plate-cleaning means comprising means for discharging fluid into the spaces between said dust-collecting plate-electrodes, and barrier means comprising a movable barrier along said tilted side for restricting fluid flow out of the spaces thereat.

14. The dust-precipitating means of claim 13, characterized further by said barrier means further comprising a second barrier along the bottom side of said assembly.

15. The system of claim 4, characterized further by said trough means comprising a trough at the downstream and upstream sides of said plate-electrodes.

16. The dust-precipitating means of claim 11 characterized further by said barrier means comprising a second barrier along the bottom side of said assembly.

17. A system of a type described, comprising an up-standing loop-circuit in which liquid can be recirculated, said loop-circuit comprising a pump in the bottom thereof an inlet pipe for said pump and a gas-treating means for receiving liquid from the outlet of said pump; means for intermittently operating said pump; a container means for holding a definite body of liquid, said container means being outside of and separate from said loop-circuit; a connecting pipe extending from said inlet pipe to a lower part of said container means; said container means being on a level with a bottom portion of said loop-circuit and being large enough to hold all of the liquid draining from said loop-circuit through said connecting pipe into said container means when said pump is not operating; said pump when operating drawing liquid from said container means through said connecting pipe and recirculating it in said loop-circuit without mixing with liquid remaining in the container means; said container means having electrostatic liquid-cleaning means therein; and means for supplying a D. C. voltage to said electrostatic liquid-cleaning means.

18. A system of a type described comprising a loop-circuit for recirculating liquid, said loop-circuit comprising: a liquid discharge device, electrostatic gas-treating means arranged to receive liquid from said liquid discharge device, a trough below the liquid discharging device, and a pump having an inlet connected to said trough; a container outside of said loop-circuit for liquid, said loop-circuit extending above said container, electrostatic liquid-cleaning means in said container, an open connection between a bottom part of said container and said pump-inlet, said connection and said pump-inlet being below the top of said trough, said container otherwise being separate from said loop-circuit, whereby liquid drawn from said container may be continuously recirculated in said loop-circuit without mixing with liquid remaining in the container.

19. A system of a type described comprising an up-standing loop-circuit in which liquid can be recirculated; said loop-circuit comprising a means in which said liquid can be contaminated and a piping arrangement for the bottom of said loop-circuit, said piping arrangement comprising a pump and an inlet pipe for said pump; means for intermittently operating said pump; a container outside of and separate from said loop-circuit for holding the liquid to be recirculated in said loop-circuit; an electrostatic liquid-cleaning means in said container; a connecting pipe outside of said loop-circuit, extending from said inlet pipe to a lower part of said container; said container being at a level with said piping arrangement and being large enough to hold all of the liquid draining into it from said loop-circuit through said connecting pipe when said pump is not operating; said pump when operating drawing liquid from said container through said pipe and recirculating liquid in said loop-circuit; said piping arrangement, said connecting pipe and said container being so arranged that liquid is automatically drawn from said container into said loop-circuit upon initial operation of said pump and liquid is recirculated in said loop-circuit by said pump during operation of said pump without mixing with liquid remaining in the container, and is automatically returned from said loop-circuit through said connecting pipe to the container upon stopping of the pump so that the liquid can be cleaned by said electrostatic liquid-cleaning means.

20. A system of a type described comprising dust-collecting means, a pump, means for periodically operating said pump, means providing a loop-circuit, including said dust-collecting means and said pump, in which liquid can be continuously recirculated, a container outside of said loop-circuit for liquid to be recirculated in said loop-circuit, electrostatic, liquid-cleaning means in said container, means comprising an open pipe connection from a portion of said container for cleaned liquid to a bottom part of said loop-circuit, said loop-circuit comprising means arranged to automatically drain liquid from said container through said pipe connection into said loop-circuit upon initial operation of said pump

and automatically return liquid from the loop-circuit through said pipe connection to the container by stopping of the pump, and to keep liquid recirculating in said loop-circuit from mixing with liquid remaining in the container.

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GAS CONDITIONER

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Fig. 1.

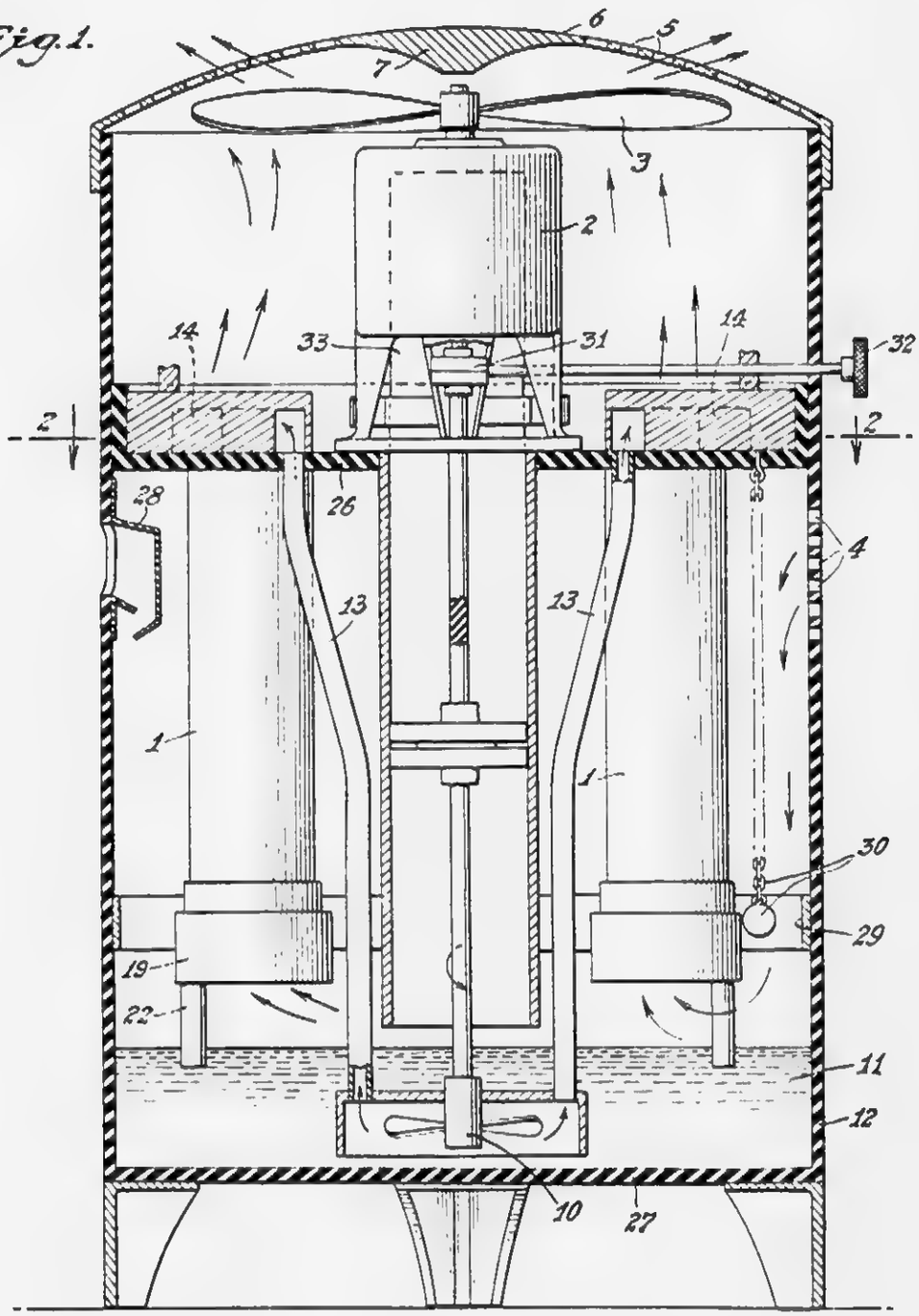

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Fig. 2.

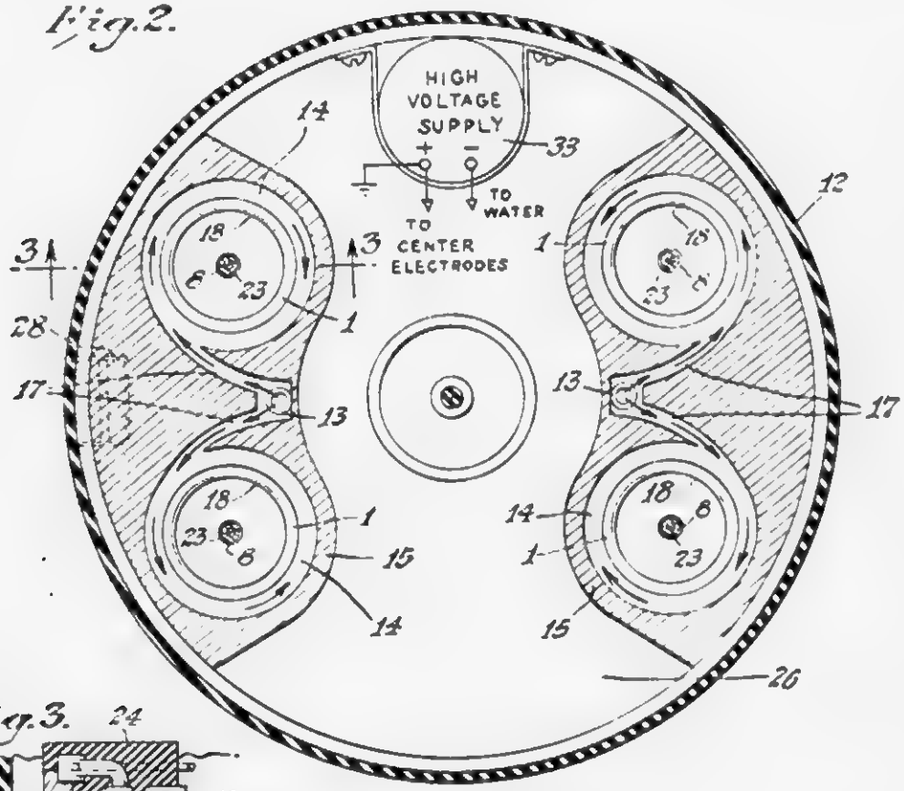


Fig. 3.

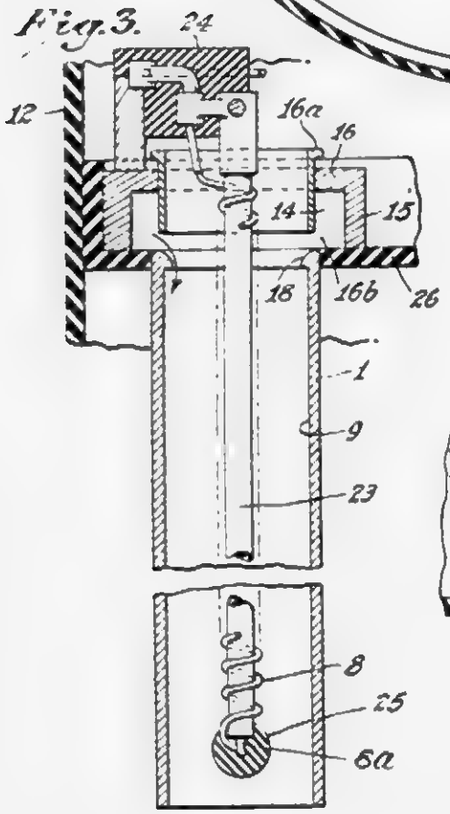
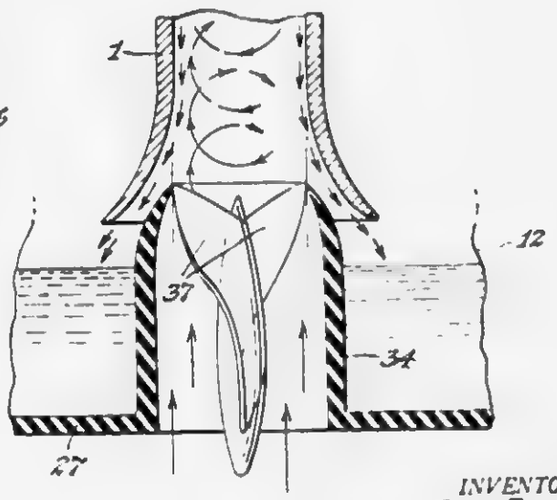


Fig. 6.



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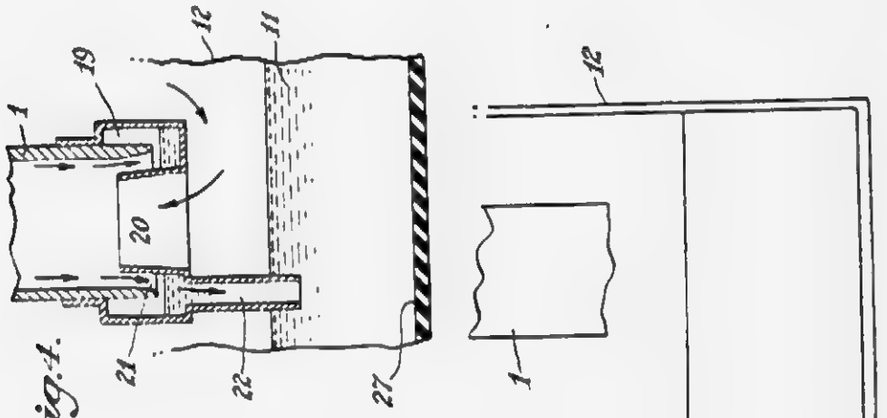

Fig. 4.

Fig. 5.

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Fig. 7.

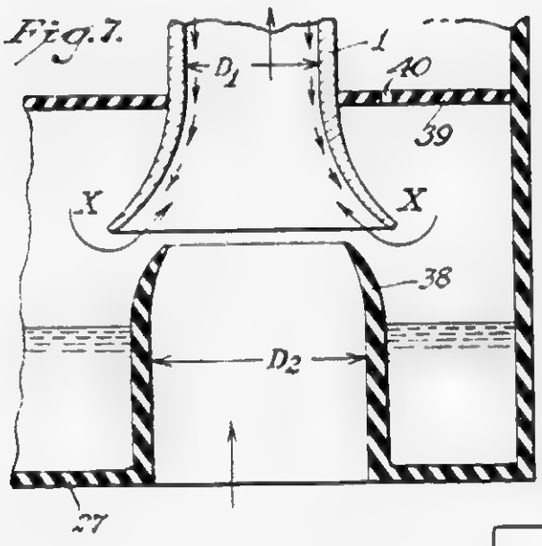

Fig. 11.

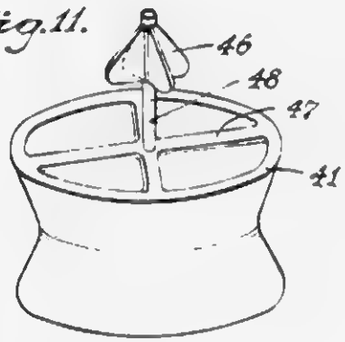

Fig. 8.

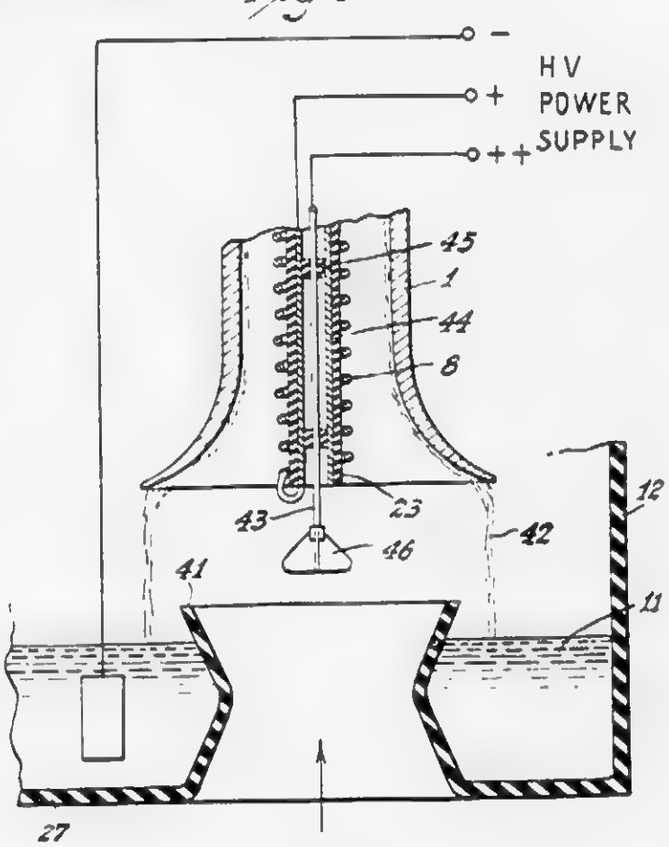

Fig. 9.

Fig. 10.

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Fig. 13.

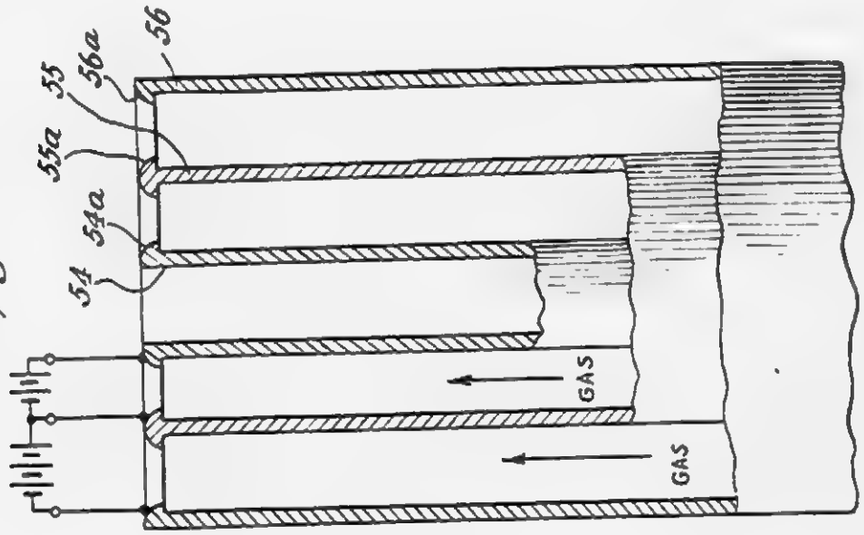
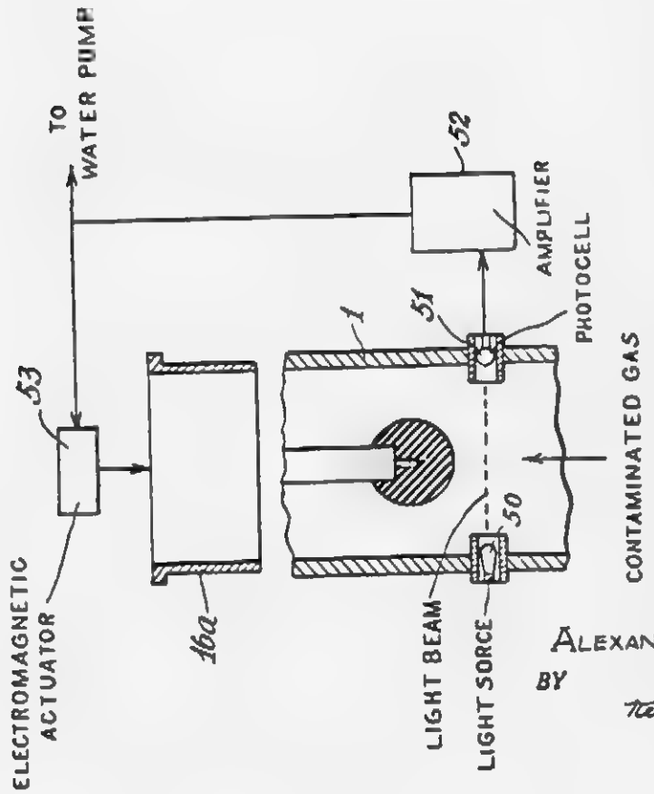


Fig. 12.



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2,937,709

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GAS CONDITIONER

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Filed Jan. 5, 1955, Ser. No. 479,909

16 Claims. (Cl. 183—7)

The present invention relates generally to gas conditioning devices, and more particularly to an improved apparatus for cleaning, humidifying and heating a gaseous stream passing therethrough. This application is a continuation-in-part of my co-pending application Serial No. 409,393, filed February 10, 1954, now abandoned.

The electrostatic precipitation of dust, smoke and like particles from the atmosphere is an art which has hitherto been confined almost exclusively to industrial applications, probably because of the unavailability of simple and effective apparatus which would not only be safe in the hands of non-industrial users but which would also withstand the abuse and lack of servicing which it would be apt to encounter in the hands of such users.

Accordingly, it is the primary object of the present invention to provide a precipitator which will satisfy the latter need, and to that end it aims at providing such essential features as: self-cleaning, operability in positions of abnormal tilt, large capacity in minimized structure, and safety against accidental electric shocks.

More particularly, it is an object of the invention to provide a gas conditioner including an electrostatic precipitator tube having a central electrode therein which is adapted not only to establish an electrostatic field in the tube for the precipitation of particles from the gaseous stream, but which also serves to heat the gas to a desired temperature. A significant feature of the invention resides in the fact that the central electrode is incandescent and self-cleaning, in that the electrical heater element thereof functions to burn off dust particles which would otherwise adhere thereto.

A further object of the invention is to provide an electrostatic precipitator of the water film type in conjunction with a heated central electrode, whereby the gas stream is both heated and humidified by evaporation from the water film. Another important feature of the invention resides in an automatic control system to adjust the thickness of the water film as a function of the density of the contaminant.

Precipitators are known which make use of a film or curtain of water along the inner wall of the tube to carry away the precipitated particles. However, wet precipitators of the type heretofore known must be carefully maintained in a level position in order to sustain the film uniformly on the inner surface of the tube. Consequently, their use is limited to stationary industrial applications. Accordingly, still another object of the invention is to provide a fluid distributor coupled to the upper end of a precipitator tube and adapted to form a substantially uniform and smooth film of water on the inner wall of the tube and to maintain the uniformity of this film even in those situations where the tube is positioned with a considerable degree of tilt, or is subjected to mechanical vibration and shock. A precipitator in accordance with the invention can be successfully applied not only to stationary industrial and home uses but to various forms of automotive transportation, such as diesel trucks, automobiles, trains, steamships, etc., without the roll, pitch, or gradient of the roadbed impairing the efficient functioning of the precipitator.

Yet another object of the invention is to provide in conjunction with an electrostatic precipitator tube of the water film type a gas inlet device adapted to feed gas into the lower end of the tube in a manner developing aerodynamic forces tending to support and smooth the water film. A gas inlet device in accordance with the invention makes possible an increased gas velocity in the tube without disruption of the water film therein.

A further object of the invention is to provide a precipitator structure including a plurality of concentric electrodes, wherein the outer electrode of one gas conduit also acts as the inner electrode of another gas conduit.

Also an object of the invention is to provide a precipitator in which the gas containing suspended particles is passed through successive electric fields, in the first of which the particles are electrically pre-ionized and in the second of which the pre-ionized particles are precipitated and trapped against redispersion into the gas stream, and are continually removed from the collecting surface. An important aspect of the pre-ionization stage in accordance with the invention is that it is anti-fouling and self-cleaning. Another outstanding feature of the invention resides in the use of a pre-ionization electrode secured to the lower end of the central electrode of the precipitator tube and functioning to stabilize the central electrode with respect to oscillations produced by the inrushing air stream.

It is also an object of the invention to provide a highly compact, mechanically rugged and efficient gas conditioning device which may be manufactured and sold at relatively low cost.

For a better understanding of the invention, as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawings wherein like components in the several views are identified by like reference numerals. In the drawings:

Fig. 1 is a vertical cross-sectional view taken through one preferred embodiment of a gas conditioning apparatus in accordance with the invention.

Fig. 2 is a horizontal cross-section taken along the line 2—2 of Fig. 1.

Fig. 3 is a longitudinal sectional view of one of the precipitator tubes and its associated fluid distributor housed within the apparatus.

Fig. 4 illustrates in section the lower portion of the precipitator tube.

Fig. 5 is a schematic circuit diagram of the electrical power supply for the apparatus.

Fig. 6 illustrates in section a first preferred modification of a precipitator tube and its associated air intake device.

Fig. 7 illustrates in section a second preferred modification of a precipitator tube and its associated air intake device.

Fig. 8 illustrates in section a third preferred modification of a precipitator tube in conjunction with an air intake device and including a pre-ionization stage.

Fig. 9 is a bottom plan view of the pre-ionization electrode employed in Fig. 8.

Fig. 10 is another form of a pre-ionization electrode.

Fig. 11 is a perspective view showing a modified support for the pre-ionization electrode.

Fig. 12 is a schematic diagram of an automatic control system for adjusting the thickness of the water film in the precipitator.

Fig. 13 illustrates diagrammatically another embodiment of a precipitator tube in accordance with the invention.

Referring now to the drawings and more particularly to the Figures 1 and 2, the preferred form of the apparatus comprises a plurality (four) of precipitator tubes 1 which are symmetrically arranged within a housing and are in the form of cylindrical conduits through which the air to be cleaned is passed while precipitation is accomplished by electrostatic fields presently to be explained. The air is propelled by the fan 3 which is driven by motor 2: it enters an intake 4 and flows downward in the direction indicated by the arrows to enter precipitators 1 through their bottoms, and it then flows up into the space around the fan and out through the annular outlet 5 in the top of the machine. The top cover 6 of the machine in which the annular outlet 5 is formed has a generally cone-shaped portion 7 depending from its center. The purpose of this cone-shaped portion is to deflect the air from the fan out of the apparatus in a horizontal direction which tends to cause the surrounding air to circulate such that contaminated air will be pushed downward outside of the apparatus and thus sucked more readily into its interior.

While the apparatus is described in connection with the conditioning of air, it is to be understood that it is applicable also to other gases, such as furnace exhausts and the like. While there is disclosed four precipitator tubes symmetrically surrounding the pumps and fan structure, it will be appreciated that any desired number of tubes may be employed for this purpose.

In accordance with one of the principal objectives of the invention, the precipitated particles are continuously washed from the precipitator tubes 1 by forming the outer or collecting electrode as a curtain of water or equivalent liquid, the uniformity of the water curtain being maintained even where the tube is tilted. This curtain is caused to flow uniformly down the cylindrical surface of the tubes 1 so that an unbroken cylinder of liquid is provided. This cylindrical curtain or cylinder of liquid is electrified by applying a potential to it with respect to the central filamentary electrode or heaters 8 positioned along the axis of the walls 9 which form the guide for the fluid. These walls may be of any suitable material, metallic or non-metallic. The fluid is caused to flow continuously by the pump 10 driven by the motor 2, the pump drawing fluid from the reservoir or pool 11 in the bottom of the housing 12 and pumping it up through the tubes 13 into the annular fluid distributor chambers 14 at the top of the precipitator tubes 1.

An important feature of the invention is the following construction which not only causes the fluid to flow in an unbroken, thin film over the entire inner surface of the walls 9 but also permits the apparatus to suffer small tilts from the vertical without destroying the uniformity of this film flow. It will be realized that apparatus designed for non-industrial usage will often be positioned other than in a strictly vertical position by non-expert users. This must be taken into account if a practical apparatus is to be had.

As best illustrated by the Fig. 3, the outer walls of the fluid distributor chambers 14 are formed by cylindrical walls 15 concentrically surrounding each tube 1 and having inwardly projecting flanges 16 to help hold the fluid in; the inner walls are formed by cylindrical collars 16*a* which are adjustable upward and downward to vary the length of the cylindrical gap 16*b* between walls 9 and collars 16*a*. This adjustability permits control of the water flow and the resultant thickness of the film flowing down walls 9.

Suitable means controllable from the exterior of the apparatus may be provided to adjust the axial positions of collars 16*a*.

The thickness of the water film may also be controlled automatically as a function of the density of the contaminant, whereby an optimum film thickness is obtained for a given density to conserve water and minimize the load on the pump. As shown in Fig. 12, this may be accomplished by means of a light source 50 mounted to project a beam across the precipitator tube, which beam is intercepted by a photocell 51 whose output will depend on the density of the gas particles blocking the light beam. The output of the photocell 51 is amplified by a suitable means 52 and fed to an actuator for controlling the position of the collar 16*a*, and hence the water gap 16*b*. The actuator may be a suitable electromagnetic device 53, such that the position of collar 16*a* is controlled automatically as a function of the density of the contaminant. At the same time the output of amplifier 52 is applied to means for controlling the water pump, whereby as the need for water increases or diminishes the pump operation is correspondingly governed.

Fluid enters fluid distributor chambers 14 tangentially through the tubes 17 which interconnect with tubes 13, as seen in Fig. 2, and whirls about the annular walls of the chambers so that it ends to enter the tubes 1 with a spiral motion. While this spiral motion helps to some extent in maintaining the unbroken uniformity of the film flowing down the walls 9, that uniformity is still better maintained by the annular inwardly projecting lips or weir ring 18 around the top edge of the tubes 1. As the liquid flows over the lips 18 in its downward course, they deflect the liquid toward the walls 9 so that it is brought into early engagement with the walls, and any tendency to dripping, or streaming of the liquid in particular paths over the surface of walls 9, is minimized. This action of the lips 18 in deflecting the course of the flowing liquid toward the walls 9 is in accordance with known hydro-dynamic principles, a familiar example of which is the tendency of fluid which is poured from a bottle or a spout to flow backward into engagement with the outer wall of the bottle or the spout even though the bottle or spout be inclined to the vertical.

The fluid distributor chamber 14 is designed not only to provide a helical flow of liquid throughout the precipitator tube but also to compel the water to cross the weir ring 18, not radially but at an angle thereto for smoother flow. In addition, the water is injected tangentially to impart thereto the required centrifugal force in order to control the water pressure at the gap 16*b*. The centrifugal force imparted to the water by the jets is also used to counteract the water pressure, thus achieving exact control of the water film and at the same time preventing the uncovering of the film at a considerable degree of tilt.

The water after passing over the weir ring 18 is diverted, in accordance with physical law, from a vertical path toward the wall of the precipitator tube 1, and therefore undergoes peripheral expansion, thereby making it possible to produce a water film as thin as desired, limited only by the inherent viscosity of the liquid. It is known from physics that if an interference is introduced on the side of a smooth column of liquid flow, the entire stream is deflected in the direction of the interference below the point of the inteference. Accordingly, the step on weir ring 18 is designed so that water is deflected sufficiently to make contact with tube 1, thereby reducing the thickness of the water film and effecting an even flow.

In order to prevent a tendency of the incoming air coming into the tubes 1 at the bottom from sucking back into the tubes 1 any water or liquid which is dripping from their bottoms into the pool 11, the construction shown at the bottom of the tubes in Fig. 1, but in better detail in Fig. 4, is provided. As indicated there, the lower end of each tube 1 is surrounded by an annular chamber 19 the inner wall of which is formed by the cylindrical portion 20 of somewhat smaller diameter than the tube 1. These portions 20 project, as indicated, into their tubes 1 and leave annular gaps 21 between themselves and the walls 9. Water flowing down the inner walls 9 goes through the gaps 21 and into the chamber 19 and from there into the pool 11 by way of the ducts

22. This effectively prevents any dripping in the path of the incoming air shown by the arrow and running through the portions 20.

Fig. 3 shows the construction of the central electrode or filament 8. They may be of any suitable form, such as the spiral configuration shown on the insulating support 23, and they may be of sufficient size that they may also be used as heaters in the event that it is desired to use the apparatus as a means of warming the air in any room in which it is used, or for humidifying by evaporation of water flowing down tubes 1. The degree of heat furnished may be readily controlled by varying current flow through the heater elements by suitable control means.

Since the high voltages to which the machine of this kind is subjected tend to cause corona and leakage losses, these are minimized by embedding at least the upper portions of the electrode structure in the insulating material 24. Moreover, the lower ends of the electrodes 8 are equipped with the balls 25 or some other suitable terminal of similar non-pointed configuration which tends to minimize corona discharge. The heating element 8 may consist of a Nichrome or other suitable resistance wire, while the insulating tube support 23 may be formed of dielectric tubing such as asbestos, glass, porcelain or glass-bonded mica.

The current path for the heater coil 8 is through the metallic core 8a is disposed centrally in dielectric tube 23 and connected at its lower end to the lower terminal of coil 8, the current return being through coil 8. By varying the size and shape of the heater wire 8 at the lower end of the center electrode, pre-ionization of the incoming gas may be effected. The heater wire is preferably operated at incandescence, thereby burning off dirt deposits. Thus the center electrode remains clean and the apparatus continues to be operative during uninterrupted use, irrespective of the precipitation density. Where the precipitator is used to draw outside air into a room, the heater electrode is of particular value in that the apparatus cleans, heats and humidifies the air fed into the room. Radiating fins distributed longitudinally on the heater wire may be used to provide a better heat exchange.

The whole apparatus is housed within the insulating, generally cylindrical housing 12 (Fig. 1), having an internal transverse wall 26, also of insulating material, for supporting the various elements, and a bottom wall 27. Occasional replenishment of the pool 11 may be accomplished by pouring liquid in the labyrinth-like inlet 28 of conductive metal. The point of this construction is that the water poured in, as from a spout, cannot drop directly to the pool 11 which might be at a dangerous potential with respect to the user. Since the water must contact the metal surface of the inlet 28 which can be grounded, there is no danger of a direct electrical connection being established between the pool 11 and the user through any column of water which might be dropping from a spout in the user's hands.

Further safety measures are the metallic ring 29 which surrounds the inner wall of the housing 12 and the metallic ball and chain 30. Both this ring 29 and the ball and chain 30 may be grounded which means that if the apparatus should accidentally be tipped during the time when dangerous voltage is applied to the pool 11, the pool 11 will flow into contact with either the ring 29 or the ball and chain 30 and thus be grounded. In any such tilting the ball and chain swings to insure engagement with the pool.

The motor 2 drives both the fan 3 and the pump 10. It may be desirable sometimes to use the unit only as a fan and not as a precipitator. In this case, the motor may be detached from pump 10 by a clutch 31 operable through a knob 32. It is understood, of course, that proper insulation between the pump 10 and the motor shaft is effected so that the dangeous potential of the pool 11 cannot be transmitted to the motor or to the knob 32, and this is readily accomplished by making portions of the motor shaft running to pump 10 of insulating material. The section of the shaft which is of insulating material should, of course, be inserted well above the water level.

Any suitable source of high voltage may be used and positioned at any suitable place in the apparatus. It is illustrated by the high voltage generator 33 (Figures 1 and 2).

In certain circumstances, it may be desirable to eliminate whatever power losses are attributable to the fact of air turbulence in the recurrent flow of the air, i.e., the flow of the air downward from the intake 4 and then in a reverse direction upward through the tubes 1. Fig. 6 illustrates a modified construction to this end. In this case, the tubes 1 need not terminate in the lower chamber 19 construction of Fig. 4. Instead, the bottom wall 27 of the apparatus is pierced by inlet tubes 34 extending upward and slightly into the tubes 1 and the side intake 4 is omitted. Air, thus, flows directly from beneath the machine upward through the tubes 1 and out the outlet 5 in a path of minimum flow resistance. This may be of considerable consequence when the machine is being designed for very maximum capacity.

In this case, the bottoms of the tubes 1 are flared outward, as shown, to prevent restriction of air flow and thereby take full advantage of their capacity. Moreover, the construction is such that the liquid of the film flows outside the tubes 34 to fall into the reservoir 11. The venturi effect produced by the constricted upper ends of tubes 34 is to be noted. The consequent air expansion as air leaves the tubes tends to help keep water against the inner walls 9 of tubes 1.

Additionally, there may be provided at the top of the tubes 34 (or cylindrical portion 20 in Fig. 4) helical, stationary blades 37(Fig. 6) which give to the air a rotary, cyclonic flow around the axis of the tubes 1. This accomplishes several purposes, as follows. First, it compels the aerosols and other particles to travel a longer distance and, therefore, remain a longer time under the influence of the electrostatic field in the tubes 1, with the net result of more efficient precipitation, i.e., more precipitation obtainable with shorter tubes or better precipitation in a tube of a given length. Secondly, it improves precipitation by giving the particles horizontal impetus under centrifugal force, thus assisting the electrostatic force and propelling the particles toward the outside electrode, i.e., the liquid film. Finally, if rotation of the air be made to coincide in direction and synchronism with the spiral rotation of the water on the surface of the tubes 1, it considerably smoothens the water flow and enables the device to operate with greater efficiency.

Fig. 5 shows the electrical circuit. The source of high voltage 33 is illustrated as a conventional electron tube generator of, say, 18 kilovolts. Its negative terminal is embedded in the pool 11 so that the pool is charged and the positive terminal is connected to grounded center electrode 8, thereby establishing an electrostatic field in the space between electrode 8 and the surrounding cylinder of water. Of course, the reverse polarity may be used relative to ground. That is to say, the center electrode could be connected to the positive terminal of the source, while the water is connected to the negative terminal and grounded. As indicated, the inlet 28 is grounded as is also ball and chain 30 and the ring 29. A suitable resistor 35 protects the high-voltage generator in case of a short circuit.

It will be understood, of course, that as the liquid (usually water) is continually pumped by pump 10 to the chambers 14 and allowed to flow uniformly down the surfaces previously indicated, the potential applied to the pool 11 by the generator 33 will also be applied

to the film of water which is flowing down the wall 9. The electrode 8 is grounded, as indicated, through the 117 v. power-line which heats it to incandescence and which also energizes the primary winding 36 of the transformer int he generator. Thus, a high potential exists between the inner electrodes 8 and the water films or curtains flowing downward over the inner surfaces of tubes 1. This high potetnial acts to remove dust, smoke and other particles from the air which is flowing through the conduit tubes 1, and the water washes it into the pool 11.

Referring now to Fig. 7, there is shown a modified form of gas inlet device for the precipitator tube 1, which tube, as in the case of Fig. 6, is flared outwardly at the bottom end to prevent restriction of the gas flow and thereby take full advantage of the tube capacity. The bottom wall 27 of the apparatus is pierced by an inlet tube 38 extending upwardly into the water pool and terminating slightly below the divergent mouth of precipitator tube 1, the upper end portion of the inlet tube being constricted. The convergent upstream wall of inlet tube 38 in conjunction with the divergent downstream wall of precipitator tube 1 produces a venturi effect wherein the resultant air expansion as the air leaves the inlet tube 38 generates a force tending to urge the downwardly flowing water against the inner wall of tube 1.

As distinguished from the inlet tube 34 in Fig. 6, the inlet tube 38 in Fig. 7 is of a larger diameter (D_2) than the diameter (D_1) of the precipitator tube 1. This feature is of particular value when a high velocity flow is being used. For when there is a high draught of suction at the top of precipitator tube 1, there is developed a corresponding pressure drop at its flared bottom, and as a consequence the fluid instead of falling into the reservoir may be drawn rearwardly into the precipitator tube 1, as indicated by arrows X. This low pressure phenomenon can be obviated only if the air intake tube 38 has an enlarged capacity. Naturally, as the air passes through the venturi of the intake tube it creates high pressure at the throat of the venturi; and by expanding into the divergent mouth of the precipitator tube two effects are attained. First, aerodynamic support is provided for the water film; second, vacuum is eliminated, thus avoiding the danger of the sucking back of water into the precipitator where it might short-circuit the high-voltage electrodes and thereby impair the normal functioning of the device.

The air streamlines formed by venturi action prevent breakup of the water film in the lower cone of the precipitator tube 1 and help create an even water curtain. High velocity air flow is therefore feasible and the system can handle a correspondingly higher volume of contaminated gas. Moreover, the contaminants in the gas are given a component of velocity in the direction of the collector electrode, thereby enhancing the efficiency of the precipitator.

Although in the normal range of air velocities, air does not flow into the chamber containing the water pool 11, with high velocity flow air from the outside might feed onto this chamber to produce local eddies at the mouth of the precipitator tube 1, which in turn suck droplets of water into the tube. This can be explained by the fact that the inrushing air does not evenly approach the peripheral gap between inlet tube 38 and precipitator tube 1, but that depending on the construction of the device and the obstacles in the path of the air stream, there are local jet airstream effects whereof cause the above-noted disturbances. Accordingly, to prevent such disturbances a baffle plate or diaphragm 39 is installed above the water pool 11 to prevent outside air flow flowing into the water chamber, whereby the air in the chamber remains tranquil and the device functions properly. To prevent a situation wherein the suction in precipitator tube 1 is so great as to create a partial vacuum in the water chamber which tends to raise the water level, the diaphragm 39 is perforated as at 40 to maintain atmospheric pressure in the water chamber and to prevent the production of local jet air streams.

An in the case of Fig. 6, the inlet tube 38 may be provided with helical stationary blades (not shown) to impart a rotary, cyclonic flow to the inrushing air about the longitudinal axis of the precipitator tube 1, the rotation of the air being made to coincide in direction and phase with the spiral rotation of the water on the surface of tube 1, thereby smoothing the water flow.

Referring now to Fig. 8, there is shown precipitator tube 1 in conjunction with an inlet tube 41 so arranged as to define a pre-ionization space, whereby incoming air containing suspended particles is passed through successive electric fields, in the first of which the particles are electrically charged and in the second of which the charged particles are precipitated and trapped against redispersion into the air stream.

Inlet tube 41 is provided with a constricted central portion to produce a venturi effect, the upper end of the inlet tube being spaced from the bottom end of the precipitator tube 1 to form a pre-ionization space therebetween which is surrounded by the curtain of water 42 flowing downwardly from the mouth of the tube 1 into the water pool 11. The central electrode of the precipitator is constituted by a dielectric tube 23 and a helical heater coil 8 wound thereon, corresponding to the same element in the embodiment in Fig. 1. Extending through the dielectric tube 23 is a coaxial line formed by an inner conductor 43 and an outer conductor 44. The outer conductor 44 serves as a current path for the heater coil 8 and is connected thereto at the lower end of the coil. The inner conductor 43, which is supported within the outer conductor 44 by suitable dielectric beads 45, projects beyond the outer conductor into the pre-ionization space. Attached to the end of inner conductor 43 and suspended therefrom are ionization electrode vanes 46, which, as shown in Fig. 9, are constituted by four vane sections in quadrature relation. These vanes which are provided with sharp edges to promote ionization effects are preferably given the aerodynamic shape of a symmetrical air foil or some other air foil suitable for the purpose of stabilization. The presence of the vanes in the air stream serves not only to afford a pre-ionization field but also to maintain the central electrode within the precipitator tube 1 in parallel relation to the air stream, thereby preventing mechanical oscillation and vibration thereof.

As with the previously disclosed devices, an electrostatic field is established between the central electrode 8 and the water film on the inner surface of tube 1, the film acting as a collector electrode and being negatively biased relative to the central electrode. The coaxial conductor arrangement 43, 44 is such that a potential independent of the central electrode potential may be impressed on the pre-ionization electrode 46, whereby the optimum electrostatic field for pre-ionization may be established in the annular space formed between electrode 46 and the surrounding water curtain 42. The potential of pre-ionization electrode 46 is fixed by consideration respecting the optimum electrostatic field for collection when center electrode 8 is grounded. Alternatively, of course, the water 11 on the pre-ionization electrode 46 may be grounded, provided the remaining electrodes maintain proper potentials for their respective functions.

It is possible also to operate the pre-ionization electrode at the same potential as that of the central electrode 8, in which event the central electrode structure may be similar to that shown in Fig. 3, with the pre-ionization electrode 46 suspended below the corona ball 25. The span of the vanes on the pre-ionization electrode could be

calculated so as to provide maximum pre-ionization without breakdown if the potential thereon is the same as on central eletrode 8. However, where it is found desirable to impress on the pre-ionization electrode a greater potential than that on the central electrode 8, as shown in Fig. 8, then the geometric configuration of the vanes could be of a lesser span or aspect ratio.

The structural means for supporting the pre-ionization electrode 46 are important only in so far as it affects the air flow. In lieu of the use of inner conductor 43 as the sole support for the electrode 46, this support may be reinforced by an insulator surrounding the conductor 43. Another satisfactory reinforcing support may be constituted, as shown separately in Fig. 11, by narrow bars 47 mounted at crossed positions on top of the inlet tube 41 and supporting at the intersection thereof a vertical insulating post 48 to which the electrode 46 may be affixed.

It is to be noted that the pre-ionization means in accordance with the invention is inherently self-cleaning, for whatever contaminant is collected by water curtain 42 is deposited in water pool 11. Thus, there is no need to dismantle the pre-ionizer for regular cleaning as with conventional devices, and the efficiency of the pre-ionizer is not diminished by the accretion of deposits. The pre-ionization electrode may also be heated to burn off particles therefrom.

While there has been disclosed in connection with Figures 8 and 9 a pre-ionization electrode having four vane sections, it will be appreciated that a greater number of vane sections may be employed successfully to establish a pre-ionization field and at the same time mechanically to stabilize the central electrode structure. Thus, as shown in Fig. 10, the pre-ionization electrode involves eight vanes in a symmetrical arrangement.

Referring now to Fig. 13 there is shown still another embodiment of a precipitator comprising a concentric arrangement of tubes. In this arrangement a center tube 54 is provided which is surrounded by a second tube 55, in turn surrounded by a third tube 56. An annular gas passage is defined between tubes 54 and 55 and another such passage is defined between tubes 55 and 56. Distributors (not shown), generally of the type disclosed in connection with Fig. 3, are provided in conjunction with the upper ends of the tubes so as to cause a water film to form on the outer surface of center tube 54 and on both the inner and outer surfaces of second tube 55, as well as on the inner surface of third tube 56. The upper ends of the tubes are provided with lips 54*a*, 55*a* and 56*a*, respectively, which lips serve the same purpose as lip 18 in Fig. 3 in conjunction with the distributor operation. It will be noted that the lip for tube 55 extends both inwardly and outwardly, for the water film is formed on both the inner and outer surfaces thereof.

Established between the water films on tubes 54 and 55 and also between the water films on tubes 55 and 56 are respective potential differences effecting the precipitation of particles from gases in the associated passages. The particles are carried by the water films into water pools, a separate water supply and pool being used in conjunction with each electrode to prevent short circuiting of the applied potentials. It is to be understood that while three concentric tubes are disclosed herein to degne two gas passages, a greater number may be employed, as desired, to produce a series of concentrically arranged annular gas passages. In practice, the different passages may be employed for contaminants which differ, for example, with respect to particle size or density, the electric field in each passage being adapted to precipitate the particular contaminant therein. Separation of the contaminants in the gas prior to their introduction into the lower ends of the tubes may be effected by conventional centrifuge means, whereby heavier particles tend to enter the outer passage and lighter particles the inner passage. It is also to be understood that a precipitator constituted by but two tubes, such as tubes 54 and 55, may be used wherein the inner and outer electrodes are constituted by water films, as distinguished from the arrangement shown in Fig. 3 wherein only the outer electrode is water film. The hollow inner tube 54 may also be provided with suitable heater means and in large installations may be so dimensioned as to serve as a housing for the power supply.

While there has been disclosed what at present are considered to be preferred embodiments of the invention, it is to be understood that many changes and modifications may be made therein without departing from the essential spirit of the invention. It is intended therefore in the appended claims to cover all such changes and modifications as fall within the true scope of the invention.

What is claimed is:

1. In an electrical precipitator, a precipitator tube through which a contaminated gas may flow in a substantially vertical direction, a flow distributor coupled to the upper end of the tube for causing liquid to flow downwardly in a uniform film over the inner surface of the tube, said distributor including an inwardly projecting lip around the upper edge of the tube defining a step between the under-surface of the lip projection and the inner surface of the tube, an annular chamber disposed above said lip and means for injecting liquid tangentially into the chamber, whereby it flows spirally over the lip and down the inner surface of the tube, the hydrodynamic action of said lip causing said liquid to form a thin film on said inner surface, said annular chamber being constituted by a cylindrical wall and a collar concentrically disposed therein to form a circular gap for admitting the liquid over said lip, said collar being axially adjustable to vary the length of the gap and thereby to control the thickness of said water film.

2. An electrical precipitator as set forth in claim 1, wherein the bottom end of said tube is flared outwardly, and a gas inlet tube for directing gas into the bottom of said precipitator tube and having a constricted upper end to produce a venturi effect.

3. An electrical precipitator as set forth in claim 1, wherein the bottom end of said tube is flared outwardly, fluid distributor means for causing fluid to pass in a uniform film over the inner surface of said precipitator tube, a gas inlet tube for directing gas into the bottom of said precipitator tube and having a constricted upper end to produce a venturi effect tending to urge said film against the wall of said precipitator tube.

4. A precipitator, as set forth in claim 3, further including spiral blades disposed in said inlet tube to impart a rotational movement to incoming gas.

5. An electrical precipitator comprising a housing having at its bottom a receptacle for a liquid pool, a vertically positioned precipitator tube disposed above said receptacle, means for passing air from which particles are to be precipitated upwardly through said tube, a flow distributor coupled to the upper end of the tube for causing liquid drawn from said pool to flow downwardly in a uniform film over the inner surface of the tube for return to said pool, said distributor including an inwardly projecting lip around the upper end of the tube defining a step between the under-surface of the lip projection and the inner surface of the tube, an annular chamber disposed above said lip constituted by a cylindrical wall and an axially adjustable collar concentrically disposed therein to form a gap admitting the liquid over said lip and means for injecting liquid drawn from said pool tangentially into the chamber, the hydrodynamic action of said lip causing said liquid to form a thin film on said inner surface, an electrode centrally within said tube, said electrode being constituted by a helix of heater wire, and means to apply a voltage to said electrode relative to said pool to establish an electrostatic field between said electrode and said film.

6. In an electrical precipitator, a precipitator tube through which a contaminated gas may flow in a substantially vertical direction, a flow distributor coupled to the upper end of the tube for causing liquid to flow downwardly in a uniform film over the inner surface of the tube, said distributor including an inwardly projecting lip around the upper edge of the tube defining a step between the under-surface of the lip projection and the inner surface of the tube, an annular chamber disposed above said lip, said annular chamber being constituted by a cylindrical wall and a collar concentrically disposed therein to form a circular gap for admitting the liquid over said lip, said collar being axially adjustable to vary the length of the gap and thereby to control the thickness of said water film, and means for injecting liquid tangentially into the chamber, whereby it flows spirally over the lip and down the inner surface of the tube, the hydrodynamic action of said lip causing said liquid to form a thin film on said inner surface, and means for imparting to the gas as it flows upwardly into said tube a rotary motion in the same direction as that of the spiral motion of the liquid whereby said liquid film is rendered smooth.

7. An electrical precipitator comprising an insulation housing having at its bottom a receptacle for a liquid pool, a vertically positioned precipitator tube disposed above said receptacle, means for passing air from which particles are to be precipitated upwardly through said tube, a flow distributor coupled to the upper end of the tube for causing liquid drawn from said pool to flow downwardly in a uniform film over the inner surface of the tube for return to said pool, said distributor including an inwardly projecting lip around the upper edge of the tube defining a step between the under-surface of the lip projection and the inner surface of the tube, an annular chamber disposed above said lip and constituted by a cylindrical wall and an axially adjustable collar concentrically disposed therein to form a gap admitting the liquid over said lip and means for injecting liquid drawn from said pool tangentially into the chamber, the hydrodynamic action of said lip causing said liquid to form a thin film on said inner surface, an electrode within said tube, and means to apply a voltage to said electrode relative to said pool to establish an electrostatic field between said electrode and said film, said electrode being constituted by an incandescent heating element for heating said gas and burning off particle deposits forming on said electrode.

8. An electrical precipitator comprising an insulation housing having at its bottom a receptacle for a liquid pool, a vertically positioned precipitator tube disposed above said receptacle, means for passing air from which particles are to be precipitated upwardly through said tube, a flow distributor coupled to the upper end of the tube for causing liquid drawn from said pool to flow downwardly in a uniform film over the inner surface of the tube for return to said pool, said distributor including an inwardly projecting lip around the upper edge of the tube defining a step between the under-surface of the lip projection and the inner surface of the tube, and means for flowing liquid drawn from said pool over the lip, the hydrodynamic action of said lip causing said liquid to form a thin film on said inner surface, an electrode within said tube, and means to apply a voltage to said electrode relative to said pool to establish an electrostatic field between said electrode and said film including a groundable labyrinth inlet for filling the pool so that incoming liquid cannot avoid direct contact with the inlet

9. An electrical precipitator comprising an insulation housing having at its bottom a receptacle for a liquid pool, a vertically positioned precipitator tube disposed above said receptacle, means for passing air from which particles are to be precipitated upwardly through said tube, a flow distributor coupled to the upper end of the tube for causing liquid drawn from said pool to flow downwardly in a uniform film over the inner surface of the tube for return to said pool, said distributor including an inwardly projecting lip around the upper edge of the tube defining a step between the under-surface of the lip projection and the inner surface of the tube, and means for flowing liquid drawn from said pool over the lip, the hydrodynamic action of said lip causing said liquid to form a thin film on said inner surface, an electrode within said tube, and means to apply a voltage to said electrode relative to said pool to establish an electrostatic field between said electrode and said film including means for grounding the liquid in the pool upon excessive tilting of said precipitator.

10. A precipitator, as set forth in claim 9, in which the means is a groundable conductive ring around the inner wall of the housing.

11. A precipitator, as set forth in claim 9, in which the means is a groundable ball and chain arranged to engage said pool upon said excessive tilt of said precipitator.

12. An electrical precipitator comprising a precipitator tube through which a contaminated gas may flow in a substantially vertical direction, the bottom end of the tube being flared outwardly, fluid distributor means including a lip surrounding the upper edge of said tube defining a step between the under-surface of the lip projection and the inner surface of the tube, and means to flow water over said lip to impart a rotational movement thereto whereby a uniform water film is formed on the inner surface of said tube, the hydrodynamic action of said lip causing said liquid to form a thin film on said inner surface, a gas inlet tube for directing gas into the bottom of said precipitator tube and having a constricted upper end to produce a venturi effect tending to urge said film against the wall of said precipitator tube, and stationary spiral blades disposed in said inlet tube to impart a rotational movement to incoming gas in the same direction as the rotational movement of said water flow.

13. A precipitator, as set forth in claim 12, wherein said inlet tube has an internal diameter greater than that of said precipitator tube.

14. An electrical precipitator comprising a housing having at its bottom a receptacle for a liquid pool, a vertically positioned precipitator tube disposed above said pool, said tube having an outwardly flared lower end, fluid distributor means coupled to the upper end of said tube for drawing liquid from said pool and causing it to flow downwardly in a uniform film over the inner surface of said tube for return to said pool, said distributor including an inwardly projecting lip around the upper edge of the tube to define a step between the undersurface of the lip projection and the inner surface of the tube, and means for flowing liquid over the lip, the hydrodynamic action of said lip causing said liquid to form a thin film on said inner surface, an electrode within said tube to establish an electrostatic field therein, a gas inlet tube piercing the bottom of said receptacle and extending through said pool up to the flared lower end of said precipitator tube to feed air therein, the upper end of said inlet tube being constricted to produce a venturi effect forcing said water film against the inner wall of said precipitator tube.

15. A precipitator, as set forth in claim 14, further including a baffle plate disposed above said pool.

16. In an electrical precipitator provided with a precipitator tube through which a contaminated gas may flow in a substantially vertical direction, the bottom end of the tube being outwardly flared, means for causing fluid to pass downwardly over the inner surface of said precipitator tube, and a gas inlet tube for directing gas into the bottom of said precipitator tube and having a constriction therein to produce a venturi effect, the upper

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end of said inlet tube being spaced longitudinally from the bottom end of said precipitator tube.

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1,250,088	Burns	Dec. 11, 1917
1,365,978	Gallager	Jan. 18, 1921
1,968,334	Crowder et al.	July 31, 1934
2,192,172	Anderson	Mar. 5, 1940
2,192,249	White	Mar. 5, 1940
2,244,279	White	June 3, 1941
2,631,684	Schmidt	Mar. 17, 1953
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2,701,028	Eilenberger	Feb. 1, 1955

FOREIGN PATENTS

197,857	Great Britain	May 24, 1923

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Notice of Appeal

Notice is hereby given that Alexander P. DeSeversky, plaintiff herein, appeals to the United States Court of Appeals for the District of Columbia from the judgment dismissing the complaint entered in this action on February 19, 1968.

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35 USC § 103. Conditions for patentability; non-obvious subject matter

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

35 USC § 112. Specification

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to

enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention. A claim may be written in independent or dependent form, and if in dependent form, it shall be construed to include all the limitations of the claim incorporated by reference into the dependent claim.

An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof. (Amended July 24, 1965, Public Law 89-83, sec. 9, 79 Stat. 261.)

35 USC § 145. Civil action to obtain patent

An applicant dissatisfied with the decision of the Board of Appeals may unless appeal has been taken to the United States Court of Customs and Patent Appeals, have remedy by civil action against the Commissioner in the United States District Court for the District of Columbia if commenced within such time after such decision, not less than sixty days, as the Commissioner appoints. The court may adjudge that such applicant is entitled to receive a patent for his invention, as specified in any of his claims involved in the decision of the Board of Appeals, as the facts in the case may appear and such adjudication shall authorize the Commissioner to issue such patent on compliance with the requirements of law. All the expenses of the proceedings shall be paid by the applicant.

APPELLANT'S BRIEF

IN THE

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

Docket No. 22202

ALEXANDER P. DESEVERSKY, *Appellant*,

v.

EDWARD J. BRENNER, Commissioner of Patents, *Appellee*.

Appeal from the Judgment of the United States District Court for the District of Columbia

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PRESS OF BYRON S. ADAMS PRINTING, INC., WASHINGTON, D. C.

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TABLE OF AUTHORITIES

* Cases chiefly relied upon are marked with asterisks.

IN THE

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v.

EDWARD J. BRENNER, Commissioner of Patents, *Appellee*.

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APPELLANT'S BRIEF

STATEMENT OF THE ISSUES

1. Whether the solution to a problem which evaded solution for more than fifty years in the active field of air pollution control can be deemed obvious;

2. In a dual-cylinder, wet electrostatic precipitator system where it was known that water had the tendency to

fly-off the outer wall of the inner cylinder, and water splash short-circuited the system, was it obvious,

a. To use water on the inner cylinder,

b. To shape the input gas undergoing cleaning in such a way that it pushed and maintained the water against the cylindrical surface.

This case has not previously been before this Court.

STATEMENT OF THE CASE

This is an appeal in an action under 35 U.S.C. 145, wherein the trial court refused to grant to appellant a certain patent claim in his application for letters patent directed to air pollution control equipment.

Appellant, Alexander P. DeSeversky, filed a patent application on August 31, 1960 entitled "Wet Electrostatic Precipitator" (App. 6). After prosecution, when the status of the application was finally determined by the Patent Office, it contained five claims of which four were allowed. The remaining claim was rejected as unpatentable over three earlier patents.

The final Patent Office action was dated July 19, 1966. This lawsuit was timely filed on September 2, 1966, tried on November 21, 1967, and decided January 24, 1968.

Implicit in the trial court decision was the premise that the entire matter had been considered by the Patent Office, and that appellant had not met the burden of "thorough conviction" necessary to overturn the Patent Office decision (App. 97). This premise was erroneous as appellant presented vitally new issues and new evidence never considered by the Patent Office.

On February 28, 1968, appellant filed a motion with the trial court requesting it to amend its judgment and to "hold" the case until the Patent Office could decide the

issues presented for the first time to the court. The motion was denied on March 26, 1968, and this appeal was timely filed on May 14, 1968.

STATEMENT OF FACTS

Many years prior to the invention described in the claim at issue, in fact, approximately fifty years earlier, a type of air pollution control equipment called an electrostatic precipitator was patented by Burns (Pat. No. 1,250,088, Def. Exh. 1, App. 125). Burns recognized that an electric charge, positive or negative, could be imparted to solid contaminants. The electrostatically charged particles could now be removed (or precipitated) from the gas or air by directing the gas through a space which is similarly electrically charged so as to repel the charged particles. The action is analogous to two magnets repelling each other.

Burns designed a tubular precipitator through which the charged contaminated air was directed. He located an electrically charged wire along the axis of the tube which repelled the charged contaminants to the tube wall. He removed the contaminants by spraying water against the tube surface.

Removal of the contaminants from the surface is essential to the continuous operation of the equipment. The charged space is dependent upon the tube surface being free of any substantial accumulation of contaminants. The practical limitation of the Burns' tubular precipitator was its small capacity (Tr. 41) (App. 57).

Its capacity was determined by the diameter of the tube, but the diameter is limited by the electric charge that can be generated between the central wire and tube wall; i.e., the larger the distance between the wire and the wall, the weaker is the charge. To increase the capacity Burns required additional independent tube systems which be-

came impractical after a certain number; he recommended three.

Thus, although Burns gave the industry a new direction, his system had such limited capacity that it was inadequate for most commercial applications (Tr. 47) (App. pp. 60 & 61).

The industry then turned its attention to the problem of increasing the capacity of the electrostatic precipitator.

In 1920, Nesbit (Pat. No. 1,357,202, Def. Exh. 1, App. 133) patented a concentric tube, *dry* precipitator. The concentric tubes provide almost limitless capacity as the polluted air is directed into the space between the tubes (not within the inner one). Thus, the distance between the tubes is constant, but the capacity is increased simply by increasing the diameter of the tubes. The charge is generated by a curtain of wires extending in the space between the tubes. (The space between the tubes appears as a donut when looking down at the concentric tubes).

The dry precipitator, however, required frequent cleaning of the facing tube surfaces. This required shutdown of the entire system while the contaminants were manually or mechanically removed from the walls.

Mechanical cleaning techniques were developed such as vibratory devices, but were never found satisfactory (Tr. 40) (App. 56). The answer, of course, was to wash down the facing surfaces. Burns taught how to wash the inside wall of a single tube. He sprayed the water onto the wall with substantial force in a rotary direction so that it spiralled down the wall in a continuous film.

It was known that water droplets were attracted to the charged wire and would electrically short-circuit the system; splash, therefore, was destructive of the system and could not be tolerated. The spraying of water against the outer tube surface presented no problem of splashing because the circularly applied water to the inside curved surface tended to push the water against the wall.

The Problem

The problem, however, was how to apply the water to the outside curved surface of the inner tube. If the water were merely applied in a circular direction to the outside surface, it would simply fly-off (Tr. 50) (App. 62). The centrifugal force which pushed the water against the outer wall now caused the water to fly-off the inner wall.

If the water were applied straight down as in a shower, it again splashed, but more seriously, the incoming high velocity air had the tendency to "peel-off" the water from the inner tube (Tr. 51) (App. 63). Thus, combining the teaching of the Burns and Nesbit patents produced an inoperable device.

This was the setting of appellant's invention. For fifty years, since Burns in 1917 and Nesbit in 1920, the industry, including appellant, strove industriously to solve the problem. There was no solution until the invention at issue.

The Invention

Appellant's concept was novel and ingenious; he sprayed water circularly onto the surface of the inner tube which normally would fly-off, but he utilized the incoming air to push the water back against the outer wall of the inner tube. If air was admitted as taught by Burns or Nesbit, it would not perform that critical function (Tr. 62-63, 88) (App. 70-71, 86). Appellant's invention was the discovery that by expanding the air as it was admitted into the space between the tubes, the air acted as a billowing cloud of great force and velocity to push the water back against the tube walls. Thus, for the first time a commercially successful, wet dual cylinder precipitator was produced.

Basis of the Lower Court's Decision

There is no dispute that the claimed invention is novel. The Patent Office and the trial court rest their decision on combining Burns and Nesbit. Evidence on the inoperability

of the combination of Burns and Nesbit was not before the Patent Office, but presented for the first time to the trial court. Further, evidence that the claimed invention was the first commercial, dual wet cylindrical precipitator after fifty years of research was not before the Patent Office, but was presented for the first time to the trial court.

ARGUMENT

The Claim at Issue

For the convenience of the Court, we have reproduced below the claim at issue, and we have italicized the portions which are novel,

> "An electrostatic precipitator for cleaning contaminated gas comprising:
>
> a. concentrically-arranged inner and outer collector tubes defining a vertically disposed annular gas passage,
>
> b. *means coupled to a well to draw liquid therefrom and to feed the liquid to the upper end of said tubes to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage,*
>
> c. *concentrically-arranged troughs at the lower ends of said tubes to receive the downwardly flowing liquid therefrom and to discharge the liquid into said well,*
>
> d. *inlet means to introduce said contaminated gas into the lower end of said annular passage between said troughs,*
>
> e. a discharge electrode structure supported within said passage,
>
> f. means to apply a high voltage between said discharge electrode structure and both of said tubes to cause migration of particles in said gas toward the films on said tubes and thereby produce a clean gas, and
>
> g. outlet means at the upper end of said annular passage to discharge the clean gas into the atmosphere."

The Invention Is Basic and Broadly Defined

Since the invention is basic, the novelty is expressed broadly, as sanctioned under 35 U.S.C. 112, in the claim section marked (b),

> "means * * * to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage."

The Novelty Was Unobvious

The record demonstrates that the only means for producing this function is the expanding gas (Tr. 44, 55) (App. 59, 65, 66). Appellant disclosed in his co-pending patent application, now Patent No. 2,937,709, Exh. 7, (App. 151), (incorporated into this case by reference) a venturi orifice at the inlet passage for producing the expanding gas. A venturi orifice is hourglass in shape. The narrow portion constricts the gas and causes it to travel at very high velocity, and upon emerging from the constricted portion, the gas undergoes immediate and rapid expansion; this phenomenon is utilized by appellant.

The rapidly expanding gas, like a billowing cloud of great force, pushes the water against the tube walls and prevents splash. The utilization of the incoming gas to perform the critical function of keeping the water away from the wires is a novel concept totally absent from the prior art. Neither Burns nor Nesbit discloses a system for producing an expanding gas (Tr. 62-64, 73, 75, 78). In (App. 70-71, 76, 77, 78, 80) the absence of an expanding gas, the system would be inoperable (Tr. 44, 55) (App. 59, 65, 66).

The Combination of Burns and Nesbit Produces an Inoperative Device

If the Burns were combined with Nesbit, the combination would be inoperative because neither teaches the use of an expanding gas (Tr. 88) (App. 86).

A prior teaching to be significant as an anticipation must suggest the invention; *Higley* v. *Brenner,* 387 F.2d 855, 128 U.S. App. D.C. 290 (1967). The skilled artisan upon reviewing the prior patents to Burns and Nesbit would not be informed of the importance of shaping the gas upon its admittance between the tubes. If the skilled artisan were to combine the teachings of Burns and Nesbit, as the Patent Office Examiner, he would obtain an inoperative device, without any suggestion whatever of the importance of shaping the gas prior to its admittance between the tubes. Inoperative prior art, is, of course, inadequate as anticipation; *Pursche* v. *Brenner,* 256 F.Supp. 217, (D.C. Dist. Col. 1966).

Further, the evidence of the inadequacies of the prior art, and the fact that combining Burns and Nesbit produced a useless and inoperative structure was presented for the first time to the court below; it had not been presented to the Patent Office. The trial court, however, assumed otherwise and erroneously imposed the burden of "thorough conviction" on appellant. The burden is appropriate only where the Patent Office had previously ruled on the same issue presented again to the court. In *California Research Corporation* v. *Ladd,* 356 F.2d 816, 123 U.S. App. D.C. 60 (1966), this Court said,

> "If the District Court goes ahead with the de novo proceeding, its decision may take into account both the burden of proof that attaches to any plaintiff, and the particular burden inherently resting on a party that seeks to change an administrative result. However, the presumption of correctness normally accorded to administrative findings is not available where an issue has not been the subject of a Patent Office finding, or an assumption underlying the Patent Office finding is demonstrably inaccurate in a material degree."

CONCLUSION

The subject matter of the invention is the first commercial electrostatic precipitator of the wet type. In this age of air pollution control, it has performed a public service. The invention has satisfied the constitutional demand; it has contributed to the public welware, and has advanced science.

We respectfully submit, the decision by the trial court should be reversed with instructions authorizing the allowance of the claim in dispute to appellant.

Respectfully submitted,

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BRIEF FOR APPELLEE

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

APPEAL No. 22202

ALEXANDER P. DESEVERSKY, APPELLANT

v.

EDWARD J. BRENNER, COMMISSIONER OF PATENTS,
APPELLEE

APPEAL FROM THE JUDGMENT OF THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF COLUMBIA

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AUTHORITIES CITED

353-095—69——1

Cases—Continued

*Cases or authorities chiefly relied upon are marked by asterisks.

STATEMENT OF THE ISSUE PRESENTED FOR REVIEW*

In the opinion of the appellee, the issue is:

Whether the findings of the District Court, that the subject matter of appellant's patent application claim 20 would have been obvious to a person of ordinary skill in the art having before him the teachings of prior United States patents to Burns, Nesbit and Penney et al., are so clearly erroneous on the evidence before it as to justify overturning the concurring decisions of the District Court and the Patent Office Tribunals on this factual question.

*The pending case was not previously before this Court under the same or similar title.

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

APPEAL No. 22202

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EDWARD J. BRENNER, COMMISSIONER OF PATENTS, APPELLEE

APPEAL FROM THE JUDGMENT OF THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF COLUMBIA

BRIEF FOR APPELLEE

STATEMENT OF THE CASE

The nature of the case and its disposition below

The appellant, Alexander P. DeSeversky, appeals from the judgment (App. 95) of the United States District Court for the District of Columbia dismissing the appellant's complaint (App. 3) in an action brought under Section 145 of Title 35, United States Code (Act of July 19, 1952, c. 950, 66 Stat. 803). In that action, the plaintiff Alexander P. DeSeversky sought to have the District Court authorize the issuance of a patent containing claim 20 of his application (P. Ex. 3) (App. 6), Serial No. 53,255, filed August 31, 1960, for a patent on a "Wet Electrostatic Precipitator".

The District Court and the Patent Office Board of Appeals refused to allow the claim on the ground of

obviousness in view of prior art under 35 U.S.C. 103 (Finding of Fact No. 10, Conclusions of Law Nos. 2 and 3) (App. 100) (D. Ex. 1, F) (App. 30). Four other claims in the application have been allowed (D. Ex. 1, F) (App. 30).

The plaintiff's application

The application discloses a wet electrostatic precipitator for cleaning contaminated or polluted air. In the disclosed precipitator (D. Ex. 1, D, Fig. 2) (App. 17), the air is drawn upwardly through an annular passage 17 between the concentric collector tubes 15, 16. Wire precipitator electrodes 41 are suspended in the annular passage and connected to a suitable high-voltage power supply 42 to cause migration of particles in the air toward the collector tubes. Both walls of the annular passage (the inner surface of the outer tube and the outer surface of the inner tube) are continuously cleaned by a uniform film of flowing water which washes the collected particles down into annular troughs 38, 38A (37), and from these troughs into a well 13. Water from the well is recirculated by a pump 14 to the top of each tube.

The claim on appeal

Claim 20 states that the invention is,

> An electrostatic precipitator for cleaning contaminated gas comprising:
>
> (a) concentrically-arranged inner and outer collector tubes defining a vertically disposed annular gas passage,
>
> (b) means coupled to a well to draw liquid therefrom and to feed the liquid to the upper

end of said tubes to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage,

(c) concentrically-arranged troughs at the lower ends of said tubes to receive the downwardly flowing liquid therefrom and to discharge the liquid into said well,

(d) inlet means to introduce said contaminated gas into the lower end of said annular passage between said troughs,

(e) a discharge electrode structure supported within said passage,

(f) means to apply a high voltage between said discharge electrode structure and both of said tubes to cause migration of particles in said gas toward the films on said tubes and thereby produce a clean gas, and

(g) outlet means at the upper end of said annular passage to discharge the clean gas into the atmosphere.

The prior art

The Patent Office examiner, the Board of Appeals and the District Court relied upon the following prior United States patents in refusing claim 20 (Findings of Fact Nos. 3, 4, 5, and 6) (App. 99):

(1) Burns, No. 1,250,088, dated December 11, 1917,

(2) Nesbit, No. 1,357,202, dated October 26, 1920,

(3) Penney et al., No. 2,448,046, dated August 31, 1948.

Each of these patents discloses a precipitator for cleaning contaminated air or a contaminated gas.

The Burns patent (D. Ex. 1, A) (App. 125) discloses the concept of a wet precipitator utilizing a flowing liquid film as an electrode (Finding of Fact No. 4) (App. 99). In the precipitator embodying this concept (D. Ex. 1, A, Fig. 2) (App. 125), the collector member 1 is a cylindrical tube, and the flowing liquid film is on the inner surface of the tube. A wire discharge electrode 3 is suspended centrally within the tube, and the gas to be cleaned is passed upwardly through the tube. A suitable potential difference is maintained between the wire discharge electrode and the tube to charge suspended particles in the gas and drive the charged particles toward the tube. The liquid is continuously supplied at the top of the tube and carries the precipitated particles into an annular trough 16 which drains into a tank 14 in the base of the separator. Three of the collector tubes are provided in the separator illustrated by Burns.

The Nesbit patent (D. Ex. 1, B) (App. 131) discloses a dry precipitator (Fig. 16 and page 6, lines 76–90) (App. 133 and 139) in which two cylindrical collector electrodes 31, 51 are concentrically arranged to provide an annular gas flow passage with discharge electrodes 34 suspended in the annular passage. In operation, gas flows upwardly through the annular passage, and particles which precipitate at the two cylindrical collector electrodes are received in troughs provided at the bottom of these electrodes. Nesbit states that one object of his invention is (D. Ex. 1, B, page 2, lines 18–26) (App. 135), "To produce an apparatus * * * which is capable of treating large streams of gaseous or other fluid media".

Penney et al., in their patent (D. Ex. 1, C) (App. 142), teach the recirculation of the liquid used in a wet precipitator to clean the dust-collecting electrodes. As shown in Fig. 1 (App. 142), troughs 74, 76 are provided below the electrodes, and the liquid draining into these troughs is continuously recirculated by a pump 98 to a discharge nozzle 38 at the upper end of the electrodes. Penney et al. state (col. 1, lines 20–28) (App. 144) that one of their objects is to provide a "self-contained cleaning means".

The ground for refusing the claim

The Patent Office Board of Appeals affirmed the examiner's rejection of claim 20 under 35 U.S.C. 103 as unpatentable over the patents to Burns, Nesbit and Penney et al. (D. Ex. 1, F, and Finding of Fact No. 3) (App. 30 and 99). The District Court concurred with the Patent Office tribunals in their refusal of claim 20 as unpatentable over the prior art (Findings of Fact Nos. 9 and 10, Conclusions of Law Nos. 2 and 3) (App. 99, 100).

The statute involved

The section of the patent statute involved in this appeal is Section 103 of Title 35, United States Code, which reads as follows:

> § 103. Conditions for Patentability; Non-Obvious Subject Matter
>
> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter

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> sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

SUMMARY OF ARGUMENT

The plaintiff in this Court has the burden of showing that the District Court was clearly wrong in finding obviousness of the subject matter of claim 20 in view of the prior art. Plaintiff has not made such a showing.

The Burns patent discloses a wet precipitator in which the collector element is a cylinder provided with a flowing liquid film on its inside surface. Plaintiff has conceded that his own outer cylinder is similar to Burns' cylinder. The Nesbit patent teaches the use of a second collector tube concentrically arranged within the first to provide an annular gas passage in a dry precipitator. Plaintiff has conceded that the difference between his device and Nesbit's is that Nesbit uses no water.

The District Court correctly found, in conformity with the findings of the Patent Office Board of Appeals, that, in view of the teaching of the Nesbit patent, the incorporation of an inner collector tube to provide an annular gas passage in the wet precipitator of Burns would be obvious to one of ordinary skill in the art, and that recirculating the liquid would be obvious in view of the teaching of this expedient in the Penney et al. patent.

The plaintiff testified at the trial that he discovered he could pass air through the precipitator at high velocity without blowing out the water by providing a venturi for the incoming air.

None of the evidence establishes that plaintiff's discovery solved a long-standing problem which had defied solution by others.

The essence of plaintiff's discovery of providing a venturi for incoming air is not recited in claim 20. This deficiency in the claim cannot properly be supplied by reference to testimony offered at the trial.

The evidence does not establish that combining the teachings of Burns and Nesbit produces an inoperative device. The plaintiff conceded that some venturi action may be present in Burns.

Commercial success has not been shown to be attributable to the substance of claim 20.

The District Court correctly imposed upon plaintiff the burden of showing, by evidence carrying "thorough conviction," that plaintiff is entitled to a patent containing claim 20.

ARGUMENT

Plaintiff's burden of proof

In *Johns-Manville Corp.* v. *Ladd,* 117 U.S. App. D.C. 262, 328 F. 2d 563 (1964), this Court said:

> * * * as we have frequently stated, the findings of the Patent Office, an expert administrative body, especially when confirmed by the District Court, will not be overturned here unless clearly infected with error. *Zenith Radio Corporation* v. *Ladd,* 114 U.S. App. D.C. 54, 57, 310 F. 2d 859, 862 (1962).

In the same *Johns-Manville* decision, this Court also stated:

> In assaying the action of the district judge, we note also that his findings "shall not be set aside unless clearly erroneous," particularly where those findings, as here, to some extent at least, are predicated on the trial court's judgment of the credibility of the witnesses appearing before it. Rule 52(a), F.R. Civ. P.

See also, *Esso Standard Oil Co.* v. *Sun Oil Co., et al.*, 97 U.S. App. D.C. 154, 229 F. 2d 37, cert. denied, 351 U.S. 973 (1956), and *Abbott et al.* v. *Coe,* 71 App. D.C. 195, 109 F. 2d 449 (1939). Plaintiff accordingly has the burden of proving that the findings of the District Court and the Patent Office are clearly erroneous or have no rational basis in the evidence before this Court. It is respectfully submitted that plaintiff has not sustained his burden, and that the decision of the District Court is amply supported by the record.

Claim 20 and the prior art

The Burns patent shows that a wet precipitator is old in which the collector element is a cylinder, or tube, and a flowing liquid film is provided on the inner surface of the tube. The plaintiff has conceded (Tr–15) (App. 40) that his own outer cylinder is similar to Burns'. The Nesbit patent shows that a second collector tube, concentrically arranged within the first to provide a second collector electrode and an annular gas passage, is old, and discloses the embodiment of this concept in a dry precipitator. The plaintiff has concended (Tr–12–13) (App. 39) that the difference

between his device and Nesbit's is that Nesbit uses no water. The Penney et al. patent shows that it is old to provide recirculating means for the liquid used in a wet precipitator.

Claim 20 calls for a wet precipitator in which these old and known elements have been combined to provide an annular gas passage between two wetted collector surfaces. The question is whether, in the light of the prior art, the combination of these old elements to provide the wet precipitator specified by the claim would have been obvious to one of ordinary skill in the art.

The advantages of the wet precipitator over the dry have been disclosed by Burns (D. Ex. 1, A, page 1, lines 55–84) (App. 126) and are well known. Plaintiff states in the specification of his application (P. Ex. 3, page 3, lines 20–22) (App. 8), that an object of his invention is "* * * to provide a wet electrostatic precipitator which is of compact design and yet has a large gas cleaning capacity". With that objective in mind, and the Nesbit patent before him, one would readily recognize that the dust-collecting capacity of the Burns device would be increased by adding a second concentric collector tube, such as that shown by Nesbit, together with means for wetting the added collecting surface so that the gas flows through an annular passage between two wetted collecting surfaces. The provision of a trough to catch liquid draining off the added collector tube calls for no more than a duplication of the trough shown by Burns. Recirculating the liquid is clearly suggested by Penney et al. as an expedient for providing a "self-contained cleaning means".

The District Court found (Findings of Fact Nos. 7 and 8) (App. 99), in conformity with the findings of the Patent Office Board of Appeals (D. Ex. 1, F, page 2) (App. 31), that:

> 7. It would constitute merely an obvious following of Nesbitt's teaching to modify the Burns device to provide it with a gas flow passage of annular rather than purely cylindrical configuration. In the light of the modification involved, and the troughs shown by Burns for collecting and discharging the liquid films, concentric troughs, one for each tubular film would be logically expected;
>
> 8. In view of the Penney et al. patent, it would be an obvious expedient to provide the Burns device with means for recirculating the liquid used therein.

It is submitted that these findings of obviousness, confirming the findings of the Patent Office Board of Appeals, are correct and amply supported by the record.

The alleged solution of a long-standing problem defying solution

In "Appellant's Brief" under the heading "Statement of Facts", plaintiff asserts (Br. 5) that he solved a problem which had long defied the attempts of others to solve. The problem, according to plaintiff (Br. 5), is how to apply water to the outside surface of the inner tube so that the water will adhere to the tube and not fly off, or be peeled off by incoming high velocity air. Plaintiff states (Br–5):

> For fifty years, since Burns in 1917 and Nesbit in 1920, the industry, including appellant, strove industriously to solve the problem. There was no solution until the invention at issue.

None of the evidence establishes that there have been *any consistent efforts* over the past fifty years to develop a precipitator which might call for the use of water on the inner tube. Plaintiff testified (Tr–29) (App. 49–50) that he first entered the field of electrostatic precipitators "When Russia exploded its hydrogen bomb * * *", and in answer to further inquiry stated (Tr–30) (App. 50), "We are talking about, well, 1950 and '51". There is no evidence that any pressing demand existed, prior to that time, for a precipitator in which the use of water on the inner tube might have been considered. The record clearly fails to establish the existence of a long felt but unsolved need as a fact tending to indicate unobviousness. See *Toledo Pressed Steel Co.* v. *Standard Parts, Inc.*, 307 U.S. 350 (1939); *Lorenz* v. *F. W. Woolworth Co.*, 305 F. 2d 102 (2nd Cir. 1962).

Evidence introduced by plaintiff at the trial

The evidence introduced by plaintiff at the trial shows that the plaintiff's objective was to pass air through a precipitator at high velocity to increase its capacity, and that the problem was to prevent the water from being blown out of the tube. In his testimony, plaintiff stated (Tr–31) (App. 51):

> Now, if you want to pass a lot of gas clean through small unit, you have to move gases very fast, and if you move gases very fast, then the water is blown right out of the tube. Even in Burns case where it is supported by centrifugal force. So there was a problem how to remove [sic] the gases fast—

The evidence introduced by plaintiff at the trial further shows that the plaintiff's solution was to provide a venturi at the bottom of the precipitator. Plaintiff stated (Tr–32) (App. 51):

> And we came upon a discovery if we introduce Venturi at the bottom of certain shape, certain configuration, the expansion of gases support the film and the water does not blow out of the unit. And it has been demonstrated many times by removing the Venturi the water at high velocity is blown right out of the unit and the unit is inoperative. By putting the Venturi where it belongs you can move the gas very fast.

It is axiomatic that the claims of an application are the correct meaure in determining whether to grant a patent. *Siegel* v. *Watson,* 105 U.S. App. D.C. 344, 267 F. 2d 621 (1959); *Ford et al.* v. *Marzall,* 90 U.S. App. D.C. 97, 193 F. 2d 710 (1951); *Seyfarth* v. *Coe,* 76 U.S. App. D.C. 96, 129 F. 2d 58 (1942).

The essence of plaintiff's discovery is not set forth in his claim. Claim 20 contains no express reference to a "venturi". Plaintiff in his testimony at the trial (Tr–57, 67–68) (App. 67, 73) sought to incorporate this venturi feature into the claim by reading it into subparagraphs (b) and (d) of the claim which call for:

> (b) means coupled to a well to draw liquid therefrom and to feed the liquid to the upper end of said tubes to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage,

> (d) inlet means to introduce said contaminated gas into the lower end of said annular passage between said troughs.

The witness, Bertram Spector, in his testimony (Tr–91) (App. 88), likewise sought to incorporate the venturi feature into the claim by relating it to subparagraphs (b) and (d). A decidedly different interpretation was placed on these subparagraphs by the plaintiff in the Patent Office (P. Ex. 3, renumbered pages 82–83) (App. 24–25) where the venturi feature was not pressed.

Aside from the clear inconsistency in the interpretation of claim language, the later-asserted construction would be clearly unsupportable. This Court pointed out in *Seyfarth* v. *Coe, supra,* that it is not at liberty to fill out a deficiency in the claim by reference to the application. This holding would seem to be equally applicable to filling out a deficiency in the claim by reference to testimony offered to the District Court. See also *Kaiser Industries Corp.* v. *McLouth Steel Corp.,* 400 F. 2d 36 (6th Cir. 1968), in which the Court refused to fill out a deficiency in the claim by reference to affidavits in the file wrapper of the patent. As the Court there noted,

> The patent law does not require a prospective inventor to search so far in attempting to determine the scope of a patent and the areas left open for inventive inquiry. Section 112 provides that it is the claims that shall *particularly point out* and *distinctly claim* the subject matter of the patentee's invention. [Emphasis quoted.]

In his brief before this Court, plaintiff contends (Br. 7) that "expanding gas" is the means called for in subparagraph (b) of the claim for producing a uniform liquid film on those surfaces of the inner and outer tubes which line the annular passage.

This interpretation of the claim clearly can not be supported as the basis for allowance of the claim. Plaintiff, referring to trial testimony (Tr–44, 45), states (Br. 7), "The record demonstrates that the only means for producing this function is the expanding gas". For the reasons noted above, the lack of an express reference to expanding gas in the claim cannot properly be supplied by reference to testimony offered to the District Court. Further, it may be noted that, although plaintiff may have provided a scientific explanation for the operation of the venturi in terms of "expanding gas", a scientific explanation is not patentable. *Aetna Steel Products Corp.* v. *Southwest Products Co.*, 282 F. 2d 323 (9th Cir. 1960).

The alleged inoperability of a device combining the teachings of Burns and Nesbit

Plaintiff contends (Br. 7) that the combination of Burns and Nesbit would be inoperative because neither teaches the use of an expanding gas.

The absence of such a teaching manifestly cannot be conclusive as proof of inoperability; the evidence establishes that the combination of Burns and Nesbit is *not* inoperative. At the trial, plaintiff was asked (Tr–49) (App. 62) "* * * did you try applying water to the outer surface of the inner cylinder and the inside surface of the outer cylinder in your initial

experimentation, and what success and failure did you have?" Plaintiff answered (Tr–49) (App. 62):

> This only worked when the gas was moving extremely slow, you see.

Moreover, plaintiff admitted that some expansion of air may occur in Burns. In answer to the question (Tr–64) (App. 71) whether air would expand in emerging from the member 17 in Figure 4 of the Burns patent (D. Ex. 1, A) (App. 125), plaintiff replied (Tr–64) (App. 71):

> Well, it may be at the very lips, he may have some expansion, but the purpose of this thing is not to produce venturi action, but simply he had to do it in order to let the water go by.

Thus, one of ordinary skill in the art would inevitably have obtained an operative device by combining the teachings of Burns and Nesbit, though he may not have known why.

Although the witness Bertram Spector testified (Tr–74) (App. 77) that "Burns is half a venturi * * *", and "It leaves discontinuous the exit end * * *", the witness' criticisms would seem to be equally applicable to the venturi shown in Figure 6 of the plaintiff's prior patent, No. 2,937,709 [1] (P. Ex. 7)

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[1] The venturi is not described in plaintiff's application, and plaintiff asserts (Br. 7) that the disclosure of a venturi in his patent, No. 2,937,709 (P. Ex. 7) (App. 151), is incorporated by reference into the application before the Court. In view of the decision of the Court of Customs and Patent Appeals in *In re Lund et al.*, 54 CCPA 1361, 376 F. 2d 982 (1967), it is questionable whether the venturi disclosure in the patent has been effectively incorporated into the instant application. Further, it is to be noted that the patent does not disclose an annular venturi.

(App. 152). If there is some distinction between the two which allows air to be passed through the plaintiff's precipitator at higher velocities, this distinction is not set forth in the claim, or disclosed.

The allegation of commercial success

Plaintiff asserts (Br. 5) that his precipitator is a commercial success. According to plaintiff's testimony (Tr-32) (App. 51–52), the venturi makes it possible to treat fast-moving air in the precipitator, and the production model is capable of handling air moving at 1600 feet per minute.

Since the venturi is not set forth in the claim, commercial success is not attributable to the substance of the claim, and therefore would not be relevant to the question of its obviousness. *Marconi Wireless Telegraph Co. of America* v. *United States,* 320 U.S. 1 (1943); *Kromer* v. *Riegel Textile Corp.,* 227 F. 2d 741 (7th Cir. 1956), cert. denied, 350 U.S. 1007. Moreover, four claims have been allowed, and plaintiff has not shown that commercial success is due, not to the substance of those claims, but to the subject matter of the rejected claim.

The allegation that the District Court erred in imposing the burden of "thorough conviction" on plaintiff

Plaintiff contends (Br. 8), under the asserted authority of *California Research Corp.* v. *Ladd,* 123 U.S. App. D.C. 60, 356 F. 2d 813 (1966) that the District Court erroneously imposed the burden of "thorough conviction" on him. Since the *California Research* case plainly has no application here, it is

apparent that the District Court properly required "thorough conviction" to overturn the Board's decision. Neither of the conditions which, under *California Research* would make the usual presumption of correctness unavailable, are present here. First, unlike the *California Research* case, the District Court in the instant case sustained the Board's decision on precisely the same grounds stated by the Board, and not on a new issue raised for the first time at the trial. Second, the new evidence introduced by plaintiff at the trial did not undercut the factual basis for the Board's findings of obviousness.

It is respectfully submitted that the District Court correctly found (Finding of Fact No. 9) App. 99–100) that "* * * the new evidence introduced by plaintiff at the trial fails to carry thorough conviction that the Board of Appeals erred in finding that claim 20 presents nothing patentable over the prior art." It is further respectfully submitted that the findings of obviousness of the District Court (Finding of Fact Nos. 7, 8 and 10) (App. 99–100) are correct and amply supported by the record.

CONCLUSION

It is submitted that, for the foregoing reasons, the conclusions reached by the Board of Appeals and the District Court, that the claim at bar is unpatentable over the prior art, as shown by the Burns, Nesbit and Penney et al. patents, cited in the decision of the Board of Appeals, are correct and have a reasonable basis in the record, and that under the standard of re-

view pointed out by this Court in *Johns-Manville Corp.* v. *Ladd, supra,* the decision of the District Court should be affirmed.

Respectfully submitted,

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APPELLANT'S REPLY BRIEF

IN THE

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

Docket No. 22202

ALEXANDER P. DESEVERSKY, *Appellant*,

v.

EDWARD J. BRENNER, Commissioner of Patents, *Appellee*.

Appeal from the Judgment of the United States District Court for the District of Columbia

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* Cases chiefly relied upon are marked with asterisks.

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ALEXANDER P. DESEVERSKY, *Appellant-Plaintiff*,

v.

EDWARD J. BRENNER, Commissioner of Patents,
Appellee-Defendant.

Appeal from the Judgment of the United States District Court for the District of Columbia

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APPELLANT'S REPLY BRIEF

Appellee argues three points:

First, the trial court found claim 20 "obvious" over the same prior patents as the Patent Office, and, therefore, it contends the burden of "thorough conviction" applies (App. 97); second the claim specifies "means" for performing the desired function without specifically stating

that the "means" is a venturi, and, therefore, says appellee, appellant is not entitled to construe the "means" clause to cover a venturi; and, third, it contends the combination of prior art was not proven inoperative. We shall reply to each of these arguments in order.

The Issue of Whether or Not the Application of Gas Through a Venturi Was "Obvious" Was Presented for the First Time to the Trial Court

Although appellee argues that the burden of "thorough conviction" should apply, it acknowledges, in its brief at page 13, that "the venturi feature was not pressed" before the Patent Office.

And yet, the venturi feature was the sole issue before the trial court.

It is true that the Patent Office and the Court below relied on the same prior art*, but that has little bearing on whether the burden of "thorough conviction" should apply. As this Court explained in *California Research Corporation* v. *Ladd,* 356 F.2d 816 (123 U.S. App. D.C. 60, 1966) the increased burden does not apply to new issues and new facts not previously reviewed by the Patent Office.

It is clear from a reading of the file history, that the issue of whether or not it was obvious to shape the incoming gas by passing it through a venturi, and using the expanded gas to perform the unique function of push-

* In its brief, appellee comments on a prior patent to Penney et al in addition to Burns and Nesbit. We discussed Burns and Nesbit in our principal brief. We did not comment on Penney et al because it was cited merely to show that the specific feature of re-using (or recirculating) the cleaning water was known in the art. We do not contend any novelty in the feature of recirculation *per se*. The patent in all other respects is completely unlike the claimed invention. For example, it is not directed to concentric tubes, or to tubes at all; nor is it concerned with shaping the gas before entry into the chamber. The patent discloses a parallel plate system where the gas is passed between the plates, and the contaminants removed through the precipitation process.

ing the water against the tubular walls was never presented, considered or determined by the Patent Office. The Court below assumed it was; the appellee in its brief admitted it was not (page 13), and that is the basis of the error on appeal.

The Form of the Claim on Appeal Is Expressly Sanctioned by the Statute

Appellee argues that appellant is not entitled to construe the claim on appeal as covering a venturi for the shaping of the gas upon entry into the precipitator. Appellee bottoms its argument on the ground that the claim does not expressly speak of a venturi.

Appellee's argument totally ignores the language of 35 U.S.C. 112. (App. 164). The statute provides,

> "An element in a claim for a combination may be expressed as a *means* or step for performing a specified function *without* the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material or acts described in the specification and equivalents thereof." (emphasis added)

This is exactly the form which appellant adopted to describe his invention in the claim on appeal. Specifically, appellant described the venturi as,

> "* * * means . . . to produce a downwardly flowing and substantially uniform liquid film on those surfaces of said inner and outer tubes which line said passage." (App. 23).

Appellee acknowledges in its brief, at page 15, that in appellant's co-pending application, the venturi is disclosed. In view of the explicit language of the statute, we are frankly at a loss to understand appellee's argument that the claim must recite a venturi in order for appellant to construe the means clause as covering the venturi. There

is no basis for such argument in the law, and the argument is in flat contradiction to the statute.

At pages 13, 14 of its brief, appellee argues that we are bound by the claim language, and the Court may not expand or restrict the claim. The authorities cited by appellee are not applicable. It is our position that no amendment to the claim is necessary or even desirable. The difference however between the situation at bar and the cases cited by appellee is that the claim before the Court is in a *pending application* and subject to change or amendment when the case is ultimately remanded to the Patent Office. The language and scope of the claims are fixed when the patent has issued. In the cases cited by appellee, the patents were issued and were not merely pending patent applications.

This Court, for example, may agree with appellant that as a matter of substance, it is unnecessary to recite the venturi, but as a matter of form, the Court may decide that it is desirable for the claim to recite expressly the venturi opening. In that event, appellant would simply amend the claim when the case was remanded to the Patent Office. Thus, this Court does have the power to determine the patentability of the claim in the form it exists, or to remand the case with the recommendation that the claim be allowed upon amendment by appellant reciting specifically the venturi opening.

The Combination of the Prior Patents Would Produce an Inoperative Structure

Appellee argues beginning at page 14 of its brief that the combination of the prior patents would not necessarily produce an inoperative structure. This argument is contrary to the record. The quotations by appellee are out of context. The testimony by Mr. DeSeversky and Dr. Spector (evidence for the first time offered to the Court

below) clearly establish that it is essential to the operation of a wet, dual-cylindrical precipitator that the contaminated gas be expanded upon entry to the chamber. It is the expanded gas that spontaneously billows out with great force to push the water against the tubular walls and to maintain the water against the walls. The witnesses testified that there was no solution to this problem until the concept of the expanding gas was realized. This concept of applying an expanded gas is totally absent from the prior patents relied upon by the Patent Office and by the Court.

Appellee argues that the combined teaching of the references would not necessarily produce an inoperative structure if the gas were admitted "extremely slowly". Air pollution equipment which could tolerate only slow movement of gas is without utility and for all practical purposes inoperable. The primary reason why Burns was unacceptable as a commercial device was because of its low capacity. It is essential to practical air cleaning equipment that the contaminated air be moved through the equipment at very high velocities, at least as fast as the gas is emitted from the equipment producing the contaminated gas. For example, a major source of contaminated gas is the public utilities and incinerators. These facilities produce contaminated gas in enormous volume; e.g., it is not uncommon for utilities to generate through their smokestacks between 100,000 and 300,000 cubic feet per minute of contaminated gas. It is unrealistic to suggest that a system is operative which permits only an "extremely slow" movement of gas.

Appellee also quotes at page 14 of its brief, a portion of Mr. DeSeversky's testimony regarding the Burns disclosure. Burns discloses a trough at the lower end of his tube in the form of a lip. The trough simply collects the water which drains off the tubular wall. Since the trough extends inwardly a very slight amount, Mr. De-

Seversky was asked in cross-examination whether this trough was in effect a venturi. The answer quoted at page 15 of appellee's brief is the first sentence of the answer, is out of context, and creates a misleading impression as to the content of the total answer. The continuation of Mr. DeSeversky's answer, omitted by appellee, reads as follows:

> "There is no venturi, no venturi action whatsoever. If there is, it is accidental, and it is not the purpose of his invention. The gap is simply made to let the water go by so that the water could be drained from the tube. . . ."

Similarly, at page 15 of appellee's brief, a quote of Dr. Spector's testimony is also taken out of context. Although Dr. Spector begins his answer by saying that,

> "Burns is half a venturi"

which is the part quoted by appellee, he clearly states during the following colloquy with the Court and the answers to additional questioning at pages Tr. 74 through 78 (App. 77 through 80) that Burns does not disclose a venturi nor does he contemplate in any respect whatever a device for expanding the gas.

It is axiomatic in the patent law that a reference is pertinent for what it teaches and its relationship to the problem solved by the subject invention; *In re Shaffer*, 229 F.2d 476, 479 (CCPA 1956),

> "* * * the following criterion is often used; namely, whether the prior art suggests doing what applicant has done."

The problem which confronted appellants was how to maintain water film on the outwardly curved surface of the inner tube. The patent to Nesbit is directed to a dry

precipitator, and, therefore, offers no solution to the problem. The patent to Burns is directed to a single tubular member where the water is applied to an inwardly curved wall. In traversing such a wall the water has a natural and normal tendency to remain on the surface. There is no problem in regard to maintaining the water film on the inwardly curved surface of the tube. A similar statement may be made regarding the water film on the outer tube of appellant's precipitator. The problem arises only when water is applied to the outwardly curved surface of the inner tube. The normal tendency of the water is to leave or fly-off that surface. That was the problem which confronted appellant and the industry for a great many years.

Mr. DeSeversky and Dr. Spector testified about their efforts in solving the problem. They explained that the mere downward application of water to the surface did not work because the incoming gas traveling at extraordinarily high velocities would simply peel the water off the surface. The application of a circularly directed water (as applied to the inwardly curved surface of the outer tube) did not work because the water would simply fly-off the surface. Burns does not address himself to the problem and in no way suggests a solution to the problem.

Appellant's unique solution, we submit, would satisfy even the outdated "flash of genius" requirement of the *Cuno Corp.* v. *Automatic Devices Corp.*, 314 U.S. 84 (1941). The solution was to shape the contaminated gas upon its entry into the chamber so that upon entry, it billowed with great force against the sides of the tubes to force and maintain the water against the tubes. We state categorically that Burns is not concerned with the problem, and in no way suggests, even remotely, the application of an expanding gas to the chamber. The references, we submit, are not pertinent in the patent law sense.

The invention is truly a break-through, and the present form of commercial dual-cylindrical precipitators is a direct result of the invention.

Respectfully submitted,

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